PUBLIC WORKS

Devoted to the interests of the engineers and technical officials of the cities, counties and states

MARCH, 1938

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TIMEWASTERS

Last Month:

Both the apple and the reservoir problems had a catch in them. The latter was neatly worked out by H. A. Blunk who sent us the correct answer—0.2 ft. per minute. Calculus is not needed, of course. Mr. Blunk also sent us the clearest explanation of how Mikey gypped himself out of 1 cent by selling apples at 5 for 2 cents, instead of 3 for 1 and 2 for 1. When Mikey sold his at 3 for 1 cent, his gross income was 1/3 cent per apple; and Ikey, at 2 for 1 cent, had a gross income of ½ cent each. The average price received was 5/12 cent, and for 60 apples, 25 cents. At 5 for 2 cents, gross income is only 2/5 cent per apple; and 5/12—2/5=1/60, which represents the mysteriously missing and utterly lost cent.

The pyramidal apples numbered 819, with 169 apples in the base of the square pyramid. This is easiest worked out by series or progression.

Loading the Truck:

A motor truck could carry 10 tons of cement, this load just filling the body. When the body was filled with form timber, it carried 3 tons. On one trip the driver brought a mixed load of cement and timber that just filled the body. The cement carried weighed 5 times as much as the timber. How much of each was there?

Grandpa and the Second-Hand Car:

Johnny had a certain sum of money. Grandpa gave him as many dollars as Johnny had cents, and as many cents as Johnny had dollars. Johnny then bought a second-hand car for $79.20. He then cast up his accounts and after much figuring found he had left exactly the same amount of money he started with. How much did he have to start with? *Contributed by Willard Peare.*

Page Messrs. Blunk, Wheeler, et al.:

A train passes a station—Podunk—at a rate of 30 m.p.h. Its speed increases and at any point exceeds the speed at Podunk by a quantity proportional to the time elapsed since leaving there. At the end of one minute, it passes North Podunk, 3,840 feet from Podunk. A second train passes Podunk 8 seconds after the first one and travels at a uniform speed of 45 m.p.h. What is the minimum distance between the trains? *Contributed by John Bevan.* *W. A. H.*

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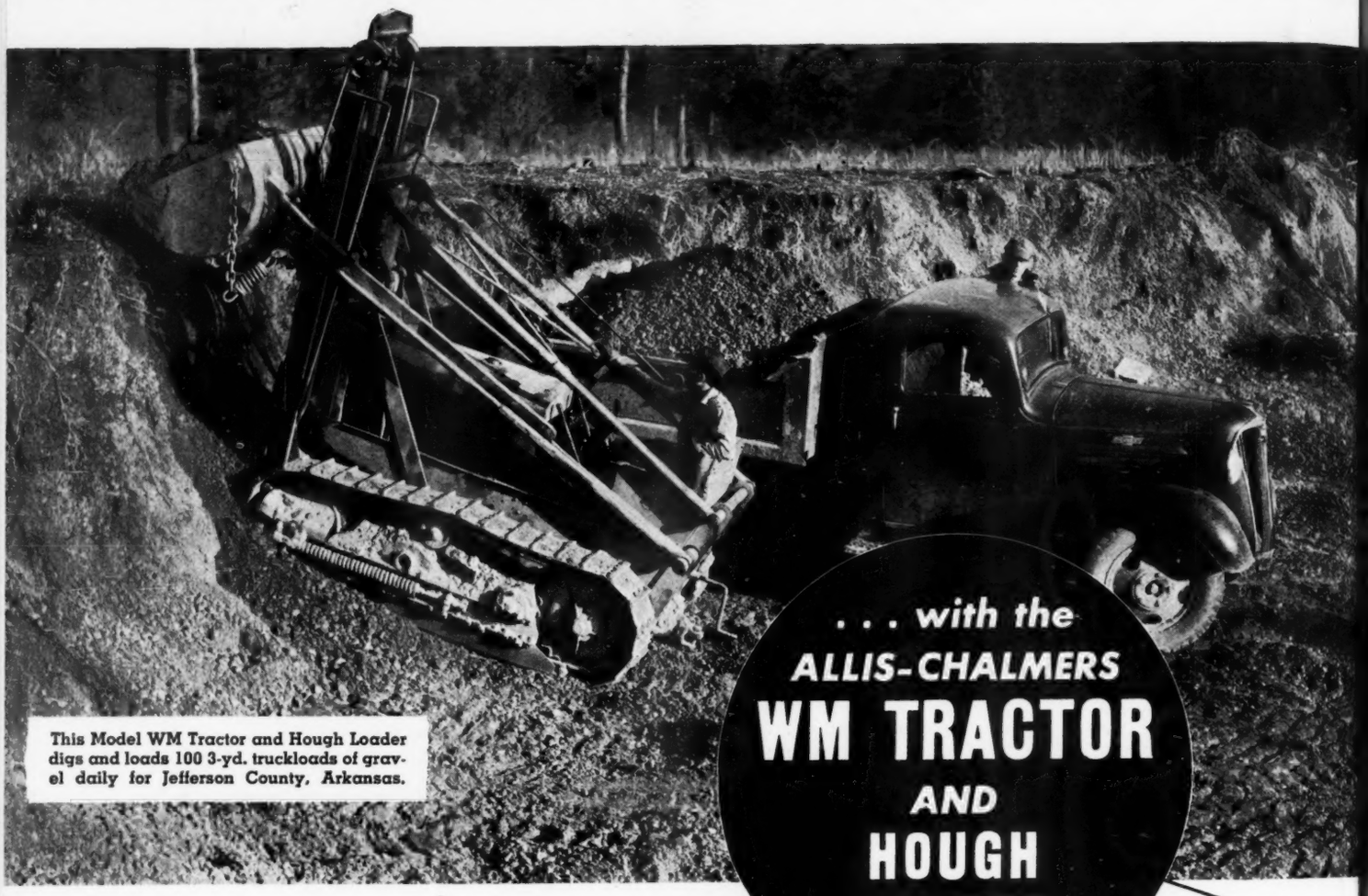

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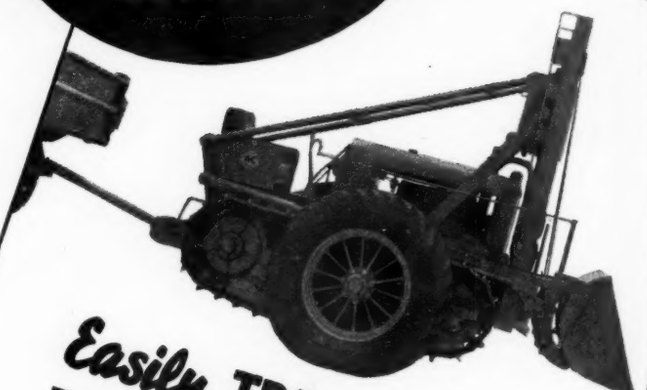

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PUBLIC WORKS
City, County and State Engineering and Construction

MARCH, 1938
Vol. 69, No. 3

Fourth section from left, square type. Right end, wedge shaped facets, one facet painted.

Unpainted. Headlights 50 to 60 feet away.

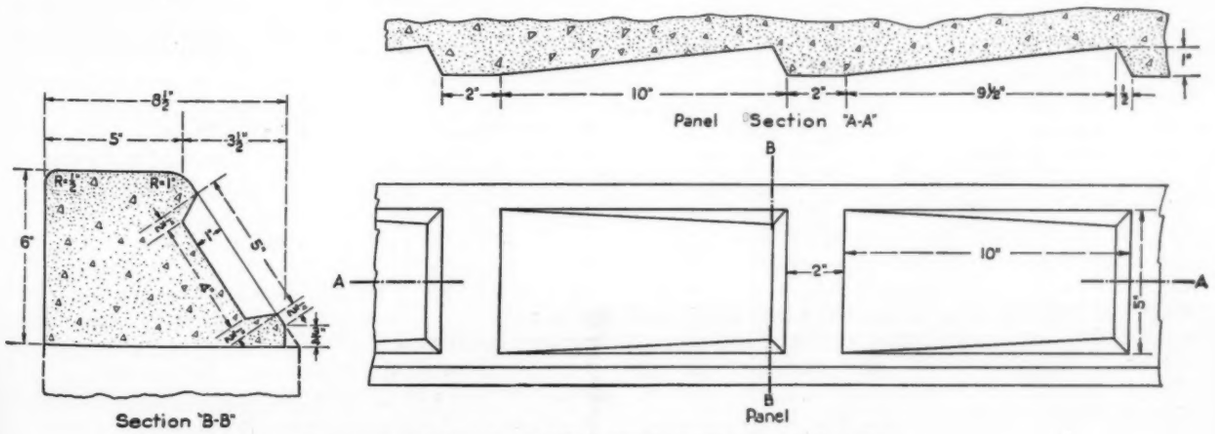
New Reflecting Type Curbs

C. F. GREEVES-CARPENTER

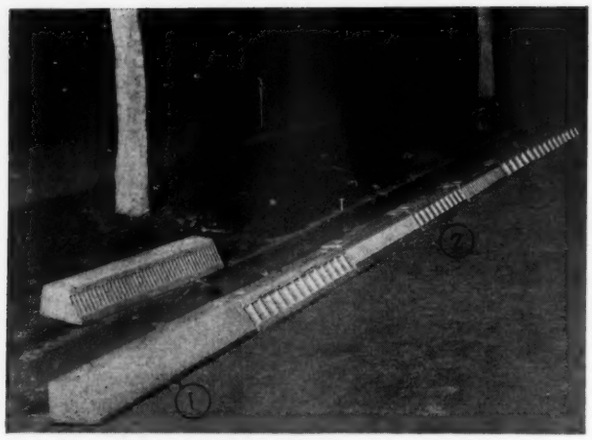
INSTEAD of the white stripe for dividing traffic lanes, a number of cities and states are using a dividing strip, which presents a physical but not unsurmountable barrier to crossing from one lane to another. At times, however, due to fog, heavy rain or unusual darkness, the curbs outlining the strip may be practically invisible. Some time ago the New Jersey State Highway Department designed a type of reflective curb which is plainly visible under all normal conditions.

Recently the California Division of Highways has adopted and installed two types of reflecting curbs as a result of test made of several designs conceived by F. J. Grumm, engineer of surveys and plans of that Division, with a view to providing a curb that would be plainly visible even in a fog, or in the headlight glare of an approaching vehicle. Test sections were made having various dimensions and face designs and batters, and paint combinations with a view to increasing their visibility. Of all the types constructed, it was found that one which had small recesses or reflecting facets was markedly superior. The depth and angle of these reflecting facets naturally determines the degree of visibility created. Two designs were adopted for trial; one, having a wedge-shaped indentation, is particularly effective for use in central dividing strips where traffic parallels the curb; the other is a block type so designed that all faces of the indentation are so sloped as to give the maximum reflective value where the headlights strike the curb at an abrupt angle, as on intersection islands and curb returns.

There has not yet been sufficient time to learn the results of these on the behavior of traffic; nor has it been possible to accumulate data on cost of installation as compared with the standard curb, but this should not be materially greater for the depressions can be formed rather simply and with no appreciable increase in cost of forms or labor. To determine the cost it is necessary to let several jobs by contract, and this is now contemplated on a project 4 or 5 miles long to be



Recessed curb face for dividing strip-front elevation and sections.



Headlight test of several types of curb for dividing strips.

built as a 4-lane divided roadway with separation strips 4 to 6 feet wide bordered by curbs.

In the experiments in which different designs were used for the reflecting faces of curb, it was discovered that white cement or white paint does not particularly increase the visibility at night under the headlights, especially where light is reflected away from the observer. All the test sections were painted white except one, and there is practically no difference in the shade or color under the headlights of the unpainted and the painted sections. It was found, however, that on the faces or facets which reflected the light back to the observer, the visibility was increased by painting. The conclusion, therefore, has been reached that the only portions of the reflecting curb which need be painted are the reflecting faces; that the curb can be built of ordinary cement concrete, thus avoiding the high cost of white cement and also the cost of painting the entire curb.

Note: For the photographs and sketches we are indebted to "California Highways and Public Works," the official publication of the Division of Highways.

Early Treatment of Concrete Slabs to Prevent Shrinkage Cracks

Observation of transverse cracking in concrete pavements shows a distinct relationship between cracking frequency and early shrinkage. Stresses in the pavement due to temperature and moisture changes can easily be accommodated by the concrete alone, even in fairly long pavement slabs, provided the concrete has been protected against the formation of shrinkage cracks before mature strength has been reached. The process of stress-curing is being developed for this purpose.

Stress-curing consists in subjecting the hardening concrete to compressive stresses which overcome the normal tension stresses due to shrinkage and surface drying. This process takes advantage of the fact that concrete is stronger in compression than tension, even at very early ages. Under pressure the slabs contract several times the amount of unaided shrinkage and the concrete is actually consolidated. This consolidation is facilitated by the low elastic modulus of the hardening concrete. Compression must at no time exceed the rapidly increasing strength of the pavement, a guide to the rate of increase of the pressure being provided in practice by a few small test specimens crushed on the job at one or two-hours intervals.

Compression is introduced at the narrow transverse joints by means of flexible pneumatic cells filling the joints and exerting uniform pressure over the cross section of the pavement. After completed stress-curing, the cells are removed for reuse. Preliminary laboratory specimens stress-cured one week, tested at 28 days, showed that the concrete so treated was not impaired, but that its strength increased slightly.

Through the cooperation of the Missouri State Highway Department an opportunity was provided to submit this construction method to a practical trial. A sidewalk 282 ft. long, 3½ ft. wide, and 4 in. thick was constructed as four monolithic slabs, two 80 ft. in length and one at each end 65 ft. and 57 ft. respectively. The concrete was not reinforced and no dowels were used at the joints. Pressure was applied at the three intermediate joints by means of pressure cells inserted flat into the joints then inflated to contact and press against the concrete. The pressure in the central joint was highest and reached a maximum of 150 lb. per sq. in. during curing.

The pressure was increased with the increasing strength as established in the supplementary crushing tests. These showed a substantially linear change in the strength of the hardening concrete at the rate of 16 lb. per sq. in. per hour from zero at three hours. The major increase in stress-cure pressure took place during the first 12 hours of age and was accompanied by a considerable widening of the joints. That this movement spread proportionately throughout the mass was shown by dial indicators placed over the 65-foot end slab at various distances from the stress-cured joint. Twelve feet from the joint the movement was 40 per cent and thirty-six feet away 12 per cent of the movement at the joint during the first night.

The slabs have been under constant observation since construction, October 12, 1936, and at the age of 13 months there was no evidence of cracking in any of them. There was no substantial shrinkage or growth of the slabs. The major changes in length corrected for temperature are due to the uncertain average temperature of the concrete, measured in an open well about 1¼ in. below the surface, and to apparent moisture changes.—*By F. V. Reagel, Missouri State Highway Department; reported in Highway Research Abstracts.*

Purpose of Construction Work Barriers

Action was brought against the City of New York for injuries by burns to a three-year-old infant who, as a result of jostling by other children, was pushed into a layer of hot tar with which the surface of the adjacent roadway was being repaired. There was no barrier around the work. It was stipulated that the barrier or guards ordinarily employed by the bureau of highways in work of this nature consists of planks of wood resting on supports, the planks being 2½ feet from the ground. On these facts, the New York Supreme Court, Trial Term, said (Greenberg v. City of New York, 298 N. Y. S. 687) "the absence of barriers was not the proximate cause of the accident. Barriers are erected to give notice that construction is in progress and to warn against undisclosed dangers. In broad daylight the very presence of the workmen is the plainest sort of notice to that effect." The complaint was therefore dismissed.

Gas Production and Utilization at the Wichita Treatment Plant

By P. L. BROCKWAY
City Engineer, Wichita, Kans.

The gas separator, Mr. Brockway in the background.

THIS plant (which was described in the February issue) was designed for a flow which at that time was about 13 mgd, including 2.5 mgd of industrial wastes. The weighted average of suspended solids was 420 ppm, or a total of 49,000 pounds per day; an average of 0.47 pound per capita for the 105,000 population.

Three digestion tanks were provided, each 75 feet in diameter and approximately 26 feet deep, with a designated location for a fourth tank whenever it should become necessary. The gas dome on each tank is 4 feet in diameter and has a 12-inch water seal. Pressure in the gas holder is equivalent to 6-inch head of water.

In operation, gas came off in such tremendous surges that the water seal was impossible to retain. Single blasts would blow it entirely out. This was cured by raising the sheet metal retainer 6 inches higher than the flat top of the gas dome and inclined inward slightly so that the blown water seal ran back down into its original location. So much gas escaped in this way that pressure was relieved by replacing the original 3-inch gas outlet pipe with a 6-inch pipe which rises vertically 6 feet above the gas dome, thus allowing the gas to leave the dome at a much lower velocity.

The escaping gas still carried out material such as hog hairs and excess moisture to the discharge line, and the plant superintendent, E. F. Miltner, placed, just outside the building over the gas dome, a separator consisting essentially of a vertical 8" pipe with inlet and outlet pipes welded into opposite sides about 4 inches below the top. The outlet pipe contains a removable basket screen of quarter-inch mesh. A vertical baffle is welded in the center of the large vertical pipe reaching from near the top down a foot or more below the inlet pipe, so that incoming blasts of gas are directed against the baffle. Water and light floating particles drop into the bottom and are drained off with a bleeder valve.

So much surplus gas was produced that an extra 3-inch pipe line was connected to each digester outlet, so arranged that each one discharges to the gas holder, or to a flame trap and thence to an open air torch which has been burning for three years.

No further difficulty has been encountered in these details. After it became proven that reasonably clean, dry gas was being obtained, a gas meter was cut into each discharge line, and a continuous daily record has been kept since the latter part of 1935.

Figure 1 shows the reason for all the details just described. The upper line indicates the weekly production from all the tanks. (We do not know any reason why the volume should increase in the spring.) Temperatures are maintained between 85° and 95° all the time, with variation from 88° to 92° most of the time.

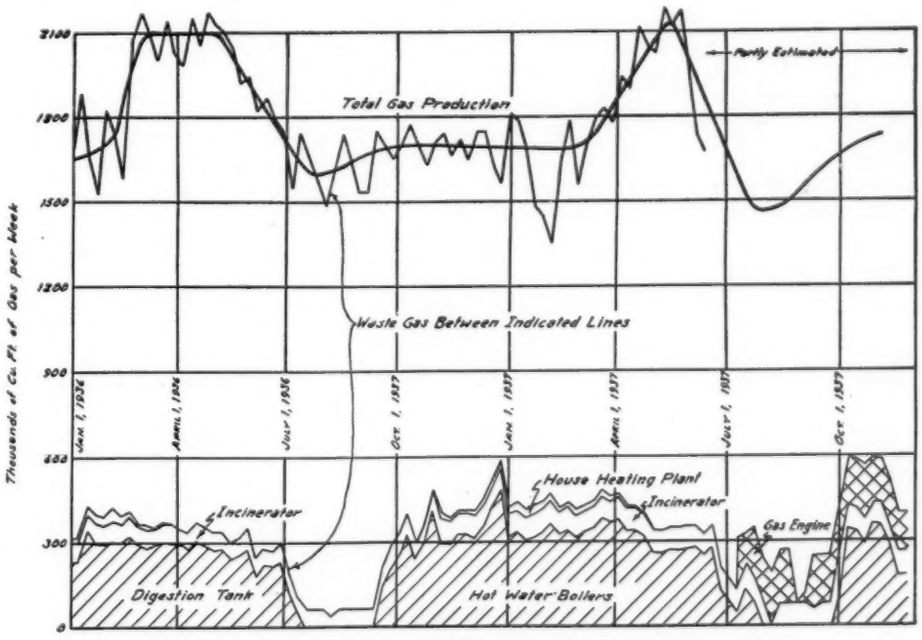


Fig. 1—Gas produced in 1936-1937 and the uses made of it.

Figure 2 shows graphically the possible variants which might affect gas production. This chart represents daily averages of the included items during the month indicated. This shows:

I. The total flow of sewage; much less than anticipated from preliminary studies, partly because industries contribute less than a million instead of 2.5 million gallons per day.

II. Average ppm solids removed. (This is admittedly subject to some question because determinations are not made daily.) Solids are inclined to run low in the summer. Most of the year the suspended solids are found to be 420 ppm or more, the same as found in preliminary studies. The plant effluent approximates 80 to 84 ppm, making 340 or more ppm removal.

III. Tons of solids; calculated from I and II.

IV. Average daily gas production as recorded by the meters. III and IV are superimposed on a ratio of 20,000 cubic feet per ton of solids removed. The maximum in March, 1936, is nearly 30,000 feet per ton and the minimum in January, 1936, about 9,000 feet.

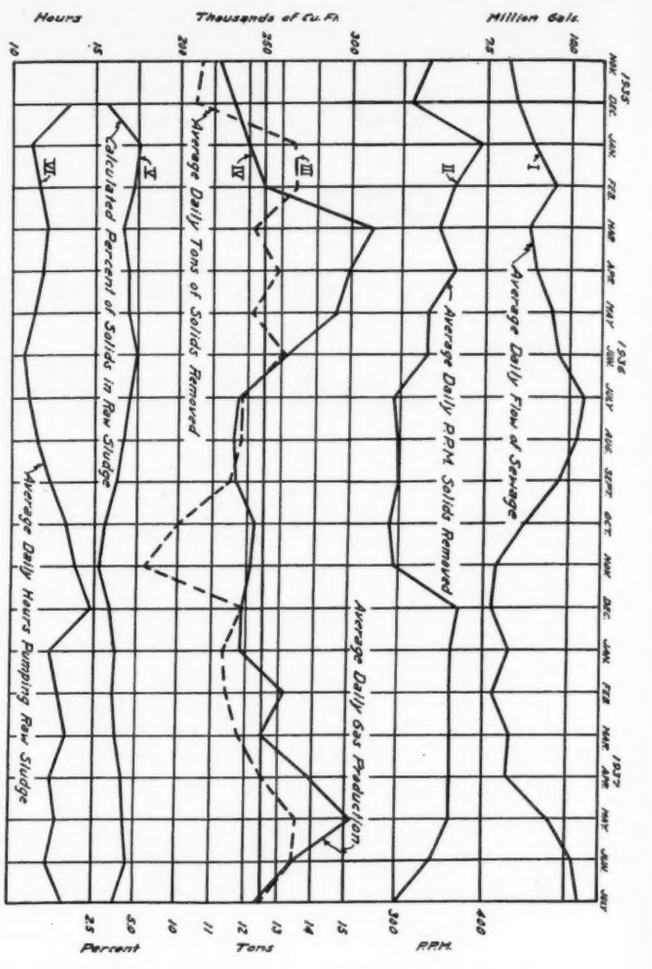
VI. Time required to pump the raw sludge into the digesters. No meters have been placed on the sludge lines, but the pumps have been roughly calibrated, by timing the draw-down in the receiving well, at 6,000 gallons per hour.

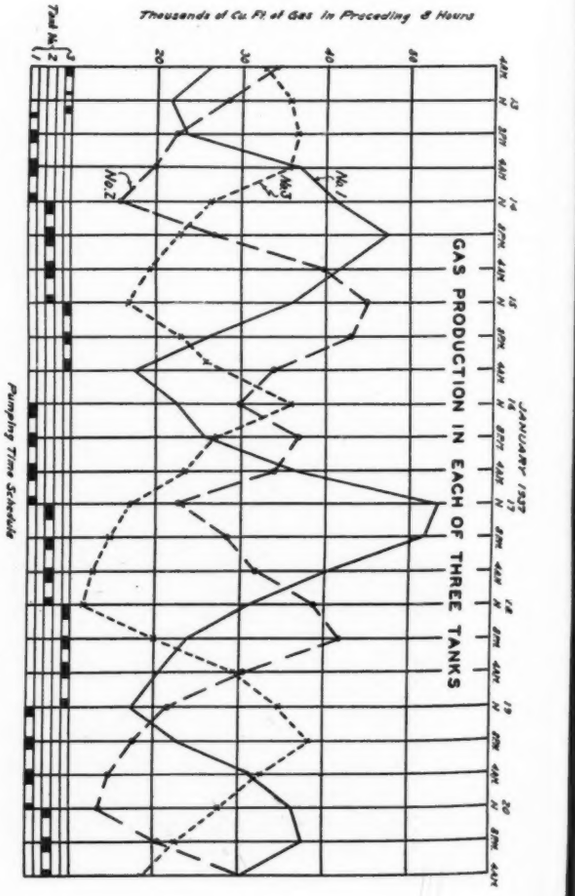
III and VI are a basis of calculating V to determine whether these observed items are in reasonable agreement. The results indicate a poor, bulky sludge in the late fall and early winter, somewhat coincident with low sewage flow. This is further supported by visual inspection. Pumping time is increased to accomplish the same results. It might be assumed that gas-forming action was merely delayed in January and February, 1936, resulting in cumulative effects in the succeeding months.

Figure 3 shows the pumping schedule in each of the three tanks, time of pumping being shaded solid. Gas meters were read each 8 hours and the volume produced during the preceding interval platted for each tank. Almost without exception these curves show the immediate effect of pumping relatively cold sludge (about 60°) and then the period of no pumping.

This is further illustrated in Figure 4. One of the tanks was filled October 21, 1937, and then allowed to run down for inspection of the interior. Gas production had almost ceased in 45 days, with a very stable sludge and clear supernatant. Temperature was purposely raised to 100° and allowed to run down without any more heat. The higher temperature produced an apparent but not marked effect on gas activity.

Figure 5 was drawn to illustrate the same point further, starting with the period of high gas production in April, 1937, and continuing into low summer production. It will be noted that sludge was pumped into each of the three tanks in regular rotation so that each has two days and a half rest period. This produces clearest supernatant return to the settling tank. Hours of pumping varied at times and is shown graphically for each tank. The total gas production in each succeeding period is platted in the upper curve. It was noted that 12 hours of pumping produced about 300,000 feet of gas in the succeeding three days. The two sets of curves are drawn with ordinates having that ratio. They are strikingly similar, but the gas production in all three tanks has a distinct down trend against the horizontal character of the volume of sludge. (We still do not know why. Does the character of our food habits at various seasons affect the chemical characteristics of body wastes? That is our unanswered question.)





At the right, Fig. 2. Above, Fig. 3.

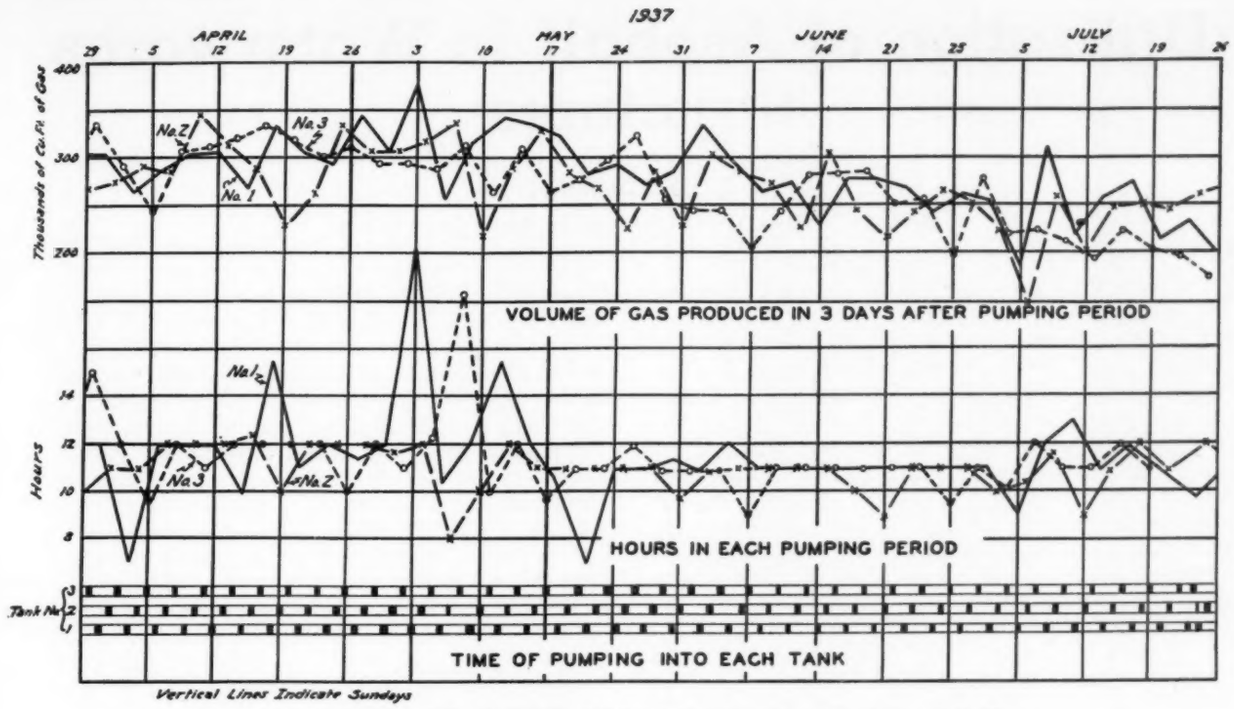


Fig. 5—Plan of feeding sludge to tanks, at 3-day intervals, and resultant gas production.

Gas production has varied from two to three feet per capita per day. It has varied from 5 to 15 cu. ft. per pound of suspended solids removed, with a median production of 10 cu. ft. Suspended solids approximate two-thirds organic and one-third mineral, so that gas production has been about 15 cu. ft. per lb. of organic solids. (Third installment follows in an early issue.)

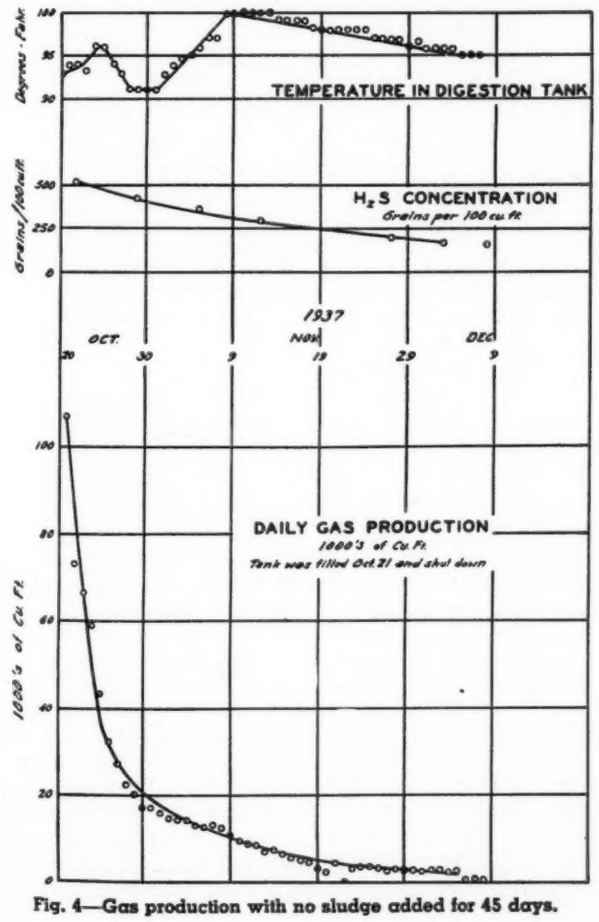


Fig. 4—Gas production with no sludge added for 45 days.

Preventing Leaky Brick Walls

During the last thirty years leaky brick walls, says the New England Brick Co. in the *Brick Kiln*, have been more prevalent than for the 300 years preceding. Curiously enough this thirty-year period has been one where the use of harsh mortars with a high cement content has been recommended, and the recommendation followed. This attempt to gain unneeded strength has been the primary cause of most leaky walls.

The tests of the Bureau of Standards, and at colleges and universities over the country, have well established the fact that these leaky walls are seldom the result of either the brick or the mortar separately, both being sufficiently impermeable to keep out moisture. These same tests indicate that a hairline crack at the junction of brick and mortar is usually responsible. These cracks are caused by the extreme expansion and contraction of mortars having high cement contents as compared to the definite lack of any expansion and contraction of the inert clay brick.

The solution seems obvious, and it is the use of mortar with less expansion and contraction, lower strength and better bonding qualities. Generally speaking, for house construction, a mortar with lime putty constituting more than half of the cementitious materials seems desirable. Lime does not expand and contract under changes in moisture content as greatly as does cement. Sand, of course, is inert.

The value of using mortar with greater bonding strength and lower tensile strength should also be mentioned. Such a mortar, even though it might crack, would not crack at the joint where brick and mortar meet, but rather through the mortar itself. Such a crack, where lime mortar is used, will heal itself over a period of time.

Lime may be used as the plasticizer and as the comparatively inert ingredient. Other preparations are also available which will serve a similar purpose—that purpose being a smooth working mortar of high bonding qualities, and sufficient compressive strength to make a safe, sure, tight job.

Utilization of Asphalt in Waterworks Structures*

J. E. BUCHANAN

Research Engineer, The Asphalt Institute, Pacific Coast Division

STORAGE of water in earthen reservoirs frequently necessitates a protective lining to eliminate percolation losses, to prevent wave erosion and to facilitate cleaning. Asphalt is beginning to develop a place among the various materials and methods used for lining reservoirs, although the possibilities have not been fully explored. There are in existence, however, enough examples of such construction with long and economical service records to warrant attention. Among them may be cited: Sawtelle reservoir, Los Angeles; Arlington reservoir, Riverside, Calif., and Iron Mountain reservoir, So. California Metropolitan Water District.

Sawtelle reservoir was constructed in 1925 by the Los Angeles Bureau of Water Works and Supply. Its principal dimensions are: Maximum height of embankment, 34 ft., area of water surface, 7.20 acres, side slopes, 2:1.

In 1929 this reservoir was given a 3-in. mixed-in-place asphaltic lining. Natural material composing the banks was rather well graded from one inch to dust. This aggregate was scarified and cultivated to a depth of 3 in. Liquid asphaltic material SC-2 was then applied in increments with continuous mixing by harrowing and disking until a total of 2 gal. per sq. yd. had been applied and uniformly mixed. This mix was then compacted by rolling. Side slopes were compacted by a front wheel of a tandem roller operated by cable from a truck. Following this, a heavy seal coat of one gal. per sq. yd. of 150-200 penetration asphalt was applied. Cost records unfortunately are not available, but this lining has given excellent service. To date the only maintenance which has been required was done in 1936, at which time about six tons of asphalt premix were used for patching scattered areas around the reservoir at the water line.

*Paper presented at Eleventh National Asphalt Conference, Memphis, Tennessee, December 6 to 10, 1937.)

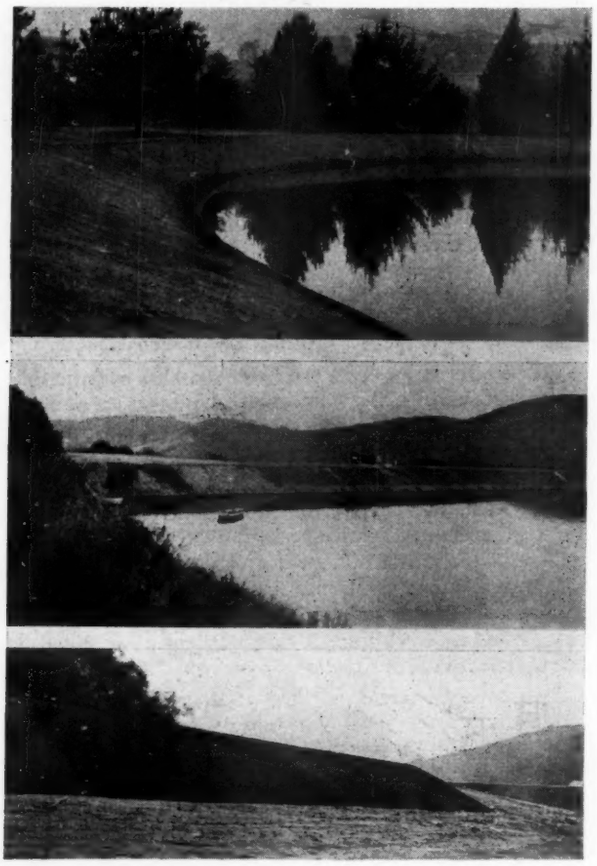


Fig. 1—Sawtelle reservoir, lined with asphalt in 1929. Photographed in February, 1937.

Fig. 2—Encino earth dam with asphaltic treatment on the upstream face.

Fig. 3—Asphalt-paved dike at Hay Canyon debris basin, Los Angeles County Flood Control District.

Arlington reservoir of the Citizen's Land and Water Company at Riverside, California, was constructed in 1930 at which time it was given a 2-in. asphalt lining at a cost of 56 cents per sq. yd. It is a 3,000,000 gallon reservoir with 3:1 sides slopes. The natural soil composing banks and bottom is disintegrated granite, well graded from one-half inch down. This soil was scarified and cultivated to kill weed growth and to produce aggregate for the asphalt lining. A total of 1¾ gal. per sq. yd. of SC-2 liquid asphaltic material was applied in increments, mixed, and compacted by rolling. Then hot asphalt, 200-350 penetration, was applied at ½ gal. per sq. yd. and covered with 80 lbs. per sq. yd. of 1" x ¼" crushed rock and again rolled. This was followed by ⅞ gal. per sq. yd. of hot asphalt, a cover of clean coarse sand and further rolling. In 1936 this reservoir was cleaned and surface treated with ¼ gal. per sq. yd. of hot asphalt covered with clean sand. While this last treatment was applied six years after the initial lining, it could have been included in the original construction. Features of this reservoir include 3:1 bank slopes, a 6-ft. walk and apron around the top, a service driveway formed in one corner and special inlet and outlet pipes.

Iron Mountain reservoir of the Metropolitan Water District of Southern California was given a 6 in. asphaltic lining in 1937 at a cost of 34 cents per sq. yd. This is one of the reservoirs on the Colorado River aqueduct system. The actual area of asphaltic lining in this reservoir is 48,900 sq. yd.

The natural material on the floor of the reservoir showed an average grading as follows:

Passing ¾ in. round	90%
Passing No. 4 sieve	70%
Passing No. 10 sieve	58%
Passing No. 50 sieve	28%
Passing No. 200 sieve	4%

This aggregate was gathered into windrows on the reservoir floor in sufficient quantity to provide a 6-in. compacted layer over the floor and sides of the reservoir. Liquid asphaltic material SC-2 was then mixed with the windrowed material by a Woods traveling mixing plant at the rate of 4 to 4½ gal. per sq. yd. of reservoir surface. The mixed material was then spread uniformly

over floor and sides and compacted by rolling. A seal coat of 150-200 penetration asphalt was then applied in two coats at the total rate of 5/8 gal. per sq. yd., following which 30 lbs. per sq. yd. of mineral aggregate passing 3/8 in. was spread, broomed, and lightly rolled.

Experience with asphaltic reservoir linings is not as broad as is the case with highway construction, but the examples cited indicate that the same general methods of construction are applicable with slight modification. There is every reason to believe that successful and economical asphaltic reservoir lining may also be accomplished using hot premix, with or without reinforcing, following the methods subsequently described for bank protection. On the basis of performance records of a good many reservoirs in Southern California, certain basic points must be considered in designing and constructing asphaltic reservoir linings. These are:

1. The asphaltic lining is flexible, within limits, and conforms with the bank or base on which it is laid.
2. The asphaltic lining is a waterproofing and erosion preventing agent only, and not a structural element.
3. Reservoir embankment should be constructed following accepted procedure for earth dam construction.
4. Sides and bottom carrying the asphaltic lining must be firm and compact and sterile as regards weed growth.
5. To be successful, the asphaltic lining itself must be well compacted and impervious. If a seal coat is used, such seal should be rather heavy and covered with mineral aggregate.
6. Outlet and inlet works should be designed so that water currents in the vicinity of such works will not create excessive drag or impact on the asphalt lining.
7. Bangs should be protected by some effective cutoff against the possibility of penetration by burrowing animals.
8. Inside slope of banks should not be steeper than 2:1 and preferably not steeper than 3:1.
9. Asphalt lining should be extended a reasonable distance across top of bank and sloped away from the reservoir to form an apron and walkway around the reservoir.
10. Berms and back slopes may be sodded or they may be treated with a simple penetration of low-viscosity asphaltic material to prevent erosion by wind and rain.

Dams and Spillways

The problem of protecting and waterproofing the upstream face of an earth dam is practically the same as that involved in reservoir lining. There are in existence, in the region around Los Angeles, several dams which have been faced with asphalt using methods and materials previously described for reservoirs.

Another contemplated use for asphalt in earth dams is in the upstream or impermeable section or core. It is significant that dense-graded asphaltic mixtures which have been developed for low-cost highway pavements employ an aggregate gradation similar to that which has been developed for earth dams. It is also interesting that the same methods of compaction are applicable in both cases. Consequently the idea of employing asphaltic mixtures in cutoff trenches and in the upstream portions of earth dams is being considered.

Another interesting use of asphalt in earth dam construction is illustrated in the case of a project now under construction near Upland, California. Present plans call for an asphaltic membrane to be placed in the upstream portion. This membrane will extend from

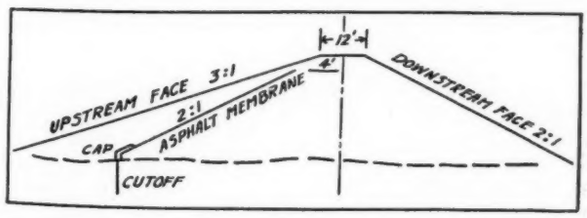


Fig. 5—Location of asphalt membrane in earth dam.

Fig. 4—Asphalt-lined ditch for carrying surface water; Los Angeles County Flood Control District.

Fig. 6—Timber spillway paved with reinforced asphaltic concrete.

Fig. 7—Completed reinforced asphaltic bank protection, San Jose Creek, Los Angeles.

the cutoff piling cap, through the dam to within 4 ft. of the top. It will be constructed by first penetrating the 2:1 slope with a cut-back asphalt, then covering this prime with asphalt saturated burlap, and finally applying a heavy seal coat of asphalt cement. The upstream face will then be built to a 3:1 slope, thus covering the membrane.

Flood control works of the Los Angeles County Flood Control District include a debris or stilling basin at the mouth of canyons wherein material eroded by rapid runoff is deposited and thus eliminated from the natural and artificial channels that carry this water to the sea. Some basins were provided with timber spillways, but these were relatively short lived due to the terrific abrasion to which they are subjected. The district elected to pave one of these spillways with asphalt. The timber spillway was surfaced with asphaltic concrete 3 in. thick, reinforced with wire fencing, which was in turn anchored to the timber structure. The asphaltic mixture was composed of 3/8 in. maximum size, dense-graded aggregate and 8 per cent of 40-50 penetration asphalt. This paving cost 13 cents per sq. ft.

Figure 6 shows this spillway after one season during which 10,000 cu. yds. or more of sand, gravel and boulders passed over it. The asphalt paving naturally suffered damage and wear, particularly at the top of the spillway where the gradient is angular instead of curved, but it illustrates the usefulness of asphalt. In this case the spillway structure was protected and preserved and the asphalt paving may be repaired to serve during the next season.

Ditches

It is recognized that there is great need for some durable and economical method of lining canals and ditches. In conveying irrigation water, linings serve to prevent seepage losses and to maintain designed cross-section and hydraulic characteristics. In soil conservation work, water must be conveyed without erosion. Surface drainage of highways must be accomplished without destruction of grade, shoulders, embankment or structures. Asphalt is advantageous for such services because of the wide range of materials which may be used and because asphaltic construction is flexible, naturally waterproof, easily maintained and repaired. For these reasons asphalt is finding increasing usefulness, particularly in the field of erosion prevention.

There are in existence examples of irrigation canals lined with asphalt with good performance records, but there are also instances where such linings have failed. The outstanding cause of failure in these cases seems to have been weed growth. Where canal banks have been sterilized prior to placing an asphalt lining, no trouble has developed. This naturally suggests a weed eradication treatment prior to lining. Perhaps the technology of the agriculturists can be utilized to achieve sterilization which, if successful, will add great impetus toward the ultimate realization of an economical and enduring canal lining.

Surveys and studies of existing asphaltic ditch and canal linings indicate the following requirements for successful performance:

1. Sides and bottom must be sterile as regards weed growth, and they must be firm and compact prior to lining.
2. Side slopes to be lined must not be too steep.
3. All asphalt linings must be well compacted and well sealed. In general it appears advisable to use a mineral cover over a seal coat to reduce the effect of actinic rays.
4. Successful linings have been placed by both penetration methods and premixes employing asphalt cements, cut-back asphalts and emulsified asphalts. In the case of cut-back asphalts and emulsions, it is essential that complete curing be achieved before the lined ditch or canal is allowed to carry water.

Bank Protection

The function of bank protection is to defend natural channels or regulation works such as dikes and levees against erosion by moving water. Man has devised and tried many schemes of bank protection to control water and preserve his investments and real values. It is known that asphalt played an important part in bank protections built in 1300 B. C., and it is still serving civilization admirably in modern constructions, as is illustrated by the following examples.

Just upstream from the intake structure of Hay Canyon debris basin, the Los Angeles County Flood Control District constructed an earth dike to direct the flow of the canyon discharge into the basin. As an experiment, the district decided to protect the dike by an asphalt facing. This dike was constructed with a 2:1 slope on the water face, which slope was carried 5 ft. below grade to form a cutoff. After grading the face, a layer of fencing was placed thereon and tied to 5-ft. pipe anchors driven into the bank on 5-ft. centers. Hot asphaltic premix was then placed on the face by hand methods to produce a compacted 3-in. layer. During placing operations the wire mesh was raised so that it would be approximately in the center of the pavement. Compaction was obtained by rolling with a 350-lb. hand roller operated by cable from a truck-mounted power winch on top of the dike. Cost of this bank protection was approximately 11 cents per sq. ft. The asphalt mixture was:

¼ in rock	46.6%
Sand	46.6%
40-50 pen. asphalt cement	6.8%

The bank protection was placed in 1936 and was subjected to very severe conditions during the winter 1936-1937. Recent inspection shows no damage or wear from this service.

San Jose Creek in Los Angeles County at certain locations was rapidly eroding its banks and encroaching upon valuable property. The first attempt to arrest erosion was a pile and wire dike at the toe of the bank. This did not solve the problem, however, and erosion progressed until a fine home and yard were in danger of complete destruction. On the basis of previous experience at Hay Canyon, the district decided to employ similar construction. The bank was sloped, compacted and paved with a 3-in. reinforced slab in substantially the same manner as described in the preceding example. In this case, however, due to running water, it was not possible to extend the paving below grade to form a cutoff. Instead, a reinforced asphaltic mattress, 2 in. thick, was placed at the toe of the slope consisting of 10 x 20-ft. slabs of asphaltic pavement each of which overlapped 5-ft. on the slab next downstream. Heavy building paper was laid between slabs so that each would be free to sink and form a cutoff as undercutting occurred. A drainage system consisting of a longitudinal drain and weepholes near the toe to the slope was installed prior to paving, to prevent uplift. This construction to date has performed admirably. In this case the flexibility, the low-cost, and the speed of construction characteristic of asphalt were advantageously employed. Cost of this work was approximately 13 cents per square foot. The asphaltic mixture was:

¼ in. rock	18.8%
Sand	68.6%
Dust	4.8%
50-60 pen. asphalt cement	7.8%

There are undoubtedly many locations where asphalt may be properly and economically utilized to protect property, structures, railways, highways by methods similar to those described in the preceding examples. Other experiments are now in progress which will not be described in detail. Notable among these are the experiments by the U. S. Engineers on the Willamette River in Oregon.

Cleaning Brick Masonry

Muriatic acid, when properly used, is an efficient means of cleaning brick masonry. The difficulty arises in impressing ordinary labor with the proper methods to be used. No solution of muriatic acid stronger than 10% acid and 90% water can be safely used for cleaning brick masonry. Even such a solution of acid should not be permitted to remain on the brick any length of time.

Improper use of acid results in "burning" and discoloration of brick. The man using acid finds that a 50-50 mix of water and acid removes dirt and mortar with considerably less effort, and being human, he gradually increases his percentage of acid, lessens his percentage of water. And then the brick are blamed because the wall doesn't look right.—The *Brick Kiln.*

These illustrations show methods by which streets are kept in repair in busy Manhattan.

How Manhattan Maintains Its Streets

By HILLIARD GOODMAN

SINCE it is part of a city that is never finished, the Borough of Manhattan in New York City is handicapped by the fact that its streets continually are being torn up or cut into to make way for plumbing, gas, and electrical connections, water lines, sewers, utility service lines, and subway excavations. In the latest annual report available, it is shown that public utilities (not including water) laid 5,615 feet of mains and services of 75 feet length or more—in addition to cuts necessitated by repairs and making consumer-service connections. Compensation is paid the Borough, for pavement restoration, by builders, when the connection is for plumbing, and by the public utilities, when the connection is for gas, telephone, or power. In 1935, for instance, repairs of this kind amounted to about 107,000 square yards.

The fact that Manhattan is always building will continue to present an obstacle to street maintenance, because it is impossible to restore the pavement to its previous condition. Not only is the surface disturbed, but also the foundation and earthwork, by the cuts.

The fine appearance and good condition of Manhattan's streets are due to the efficiency of street construction methods — good design, rigid specifications, and superior workmanship—and to progressive maintenance policies. For instance, the granite blocks, used on heavier traffic streets, are inspected from the time they are cut at the quarry to the placement in the street. Equally strict inspection is maintained on other types. The chemical and physical testing laboratory tests all paving materials including surfaces, binders, mixtures, fillers, aggregates, and all foundation materials. Private contractors guarantee the satisfactory service of their jobs over a period of years, depending on the materials and the use to which the street is subjected.

Using a surface heater.

The Engineering Bureau keeps a record of every street pavement in the borough: The type of pavement, when it was laid, its condition from year to year, and recommendations for improvement, where needed. The chief engineer makes an annual inspection of every street to ascertain the extent of maintenance and cost required to keep it in first class condition, the grade he gives it being "good," "fair," or "poor."

Three principal types of surfaces are used, all on 6-in. to 9-in. concrete base: Sheet asphalt, with 1½-inch top, and 1½-inch binder; granite block, with 5½-in. block, 1½-in. binder and 1-in. mortar bed base; and asphalt block, with 4-in. block top, 1½-in. binder and 1-in. mortar base.

The Maintenance Division cares for Manhattan's 490 miles of paved streets and five miles of unpaved streets —in addition to 550 miles of sewers. It has one asphalt plant, at 90th Street and the East River, which produced, in 1935, 60,802 boxes of wearing surface (45,602 tons); 30,259 boxes of close binder (22,694 tons); 1,395 boxes asphalt concrete—in 197 operating days. As an illustration of the volume of materials, there were unloaded at the dock serving the plant, 1,500,000 gallons of asphaltic cement, 16,000 cubic yards of ¾-inch binder stone, 40,000 cubic yds. of asphalt sand and 6,500 tons of inorganic dust, plus coal, fuel oil, kerosene and gasoline—210,000 gallons of the latter. Equipment used includes 37 inspection automobiles, 104 motor trucks, 4 pumps and 8 compressors.

In addition to the one asphalt plant, there are five "corporation yards," where materials, for the use of the Maintenance Division, are stored by the Department of Purchase.

Mixed asphalt is carried, from plant to job, in steel-bodied, asbestos-lined trucks—with 5-8 tons capacity—covered by tarpaulins. For a re-surfacing operation, a surface heater, mounted on a truck, and using fuel oil, heats ¼- to ½-inch of the top paving, which is removed by scrapers. For cutting into the asphalt paving, air compressors are used in 90 per cent of all cases.

The highway forces of the Maintenance Division are organized into asphalt, stone concrete and emergency gangs. The 17 asphalt pavement gangs aggregate 242

men. Average composition is, 1 foreman, 1 roller engineer, 1 raker, 2 tampers, 1 smoother, 1 top shoveller and 7 laborers. J. W. Petty and A. Etzel are supervisors.

There are 15 gangs of 126 men on granite and stone work, the average composition being 1 foreman, 1 rammer, 3 pavers and 6 laborers. John J. Duffy is supervisor.

The concrete gangs, of which William Van Dem Dries is supervisor, are ordinarily made up of 1 foreman and 5 laborers. The emergency gang consists of one driver who acts as foreman and 2 asphalt workers.

Of great importance to Manhattan's street maintenance and improvement program is the Works Progress Administration, which has been cooperating with municipal departments for two and a half years. Because of WPA's existence, the Paving Section of the Division of Design, which plans the work of the Engineering Bureau, changed the method for preparing contracts for street widening and repaving.

Most of the work of excavating, grading, and placing the concrete foundation—plus relocating hydrants and traffic posts on street widenings—was turned over to them. Private contractors still furnish and lay the surface paving. In 1935, there were let 15 contracts (in which from one to as many as sixteen locations were covered in a single contract) representing 68 streets with a paving area of 297,000 square yards. However, 12 contracts, covering 67,440 square yards of paving, were let to include all work, both foundation and surface as well as preparing the grading.

Details of Maintenance

When a cut has been made in the street, a concrete base is installed consisting of 5 parts coarse aggregate; 1 part sand; 1 part cement. Concrete mixers are not used to repair cuts; the mixing is done by hand labor. In every case, the foundation is tamped before the cut is fixed. In order to secure a good bond, the edges of the cut are neatly cleaned. The repairs to the foundation are made by the concrete gang, the surface being laid by the asphalt gang. In some cases ready-mixed cement is purchased delivered on the job.

Wherever pot holes exist in asphalt, they are cut out. If the foundation has been undermined, it is repaired. If merely the surface is to be fixed, 1 to 1½ inches of binder and 1½ to 2 inches of sheet asphalt are laid—depending on the thickness of the street paving. The surface is then rolled.

With worn or wavy surfaces, the surface is removed by hand burners on small jobs, and by large burners, mounted on trucks, on the more important jobs. These large burners are usually used if an entire block is repaired, and are hired by contract—usually from June first to December first.

From ¼ inch to 1 inch is burned off by the surface heaters, depending on the depth of the waves or the extent to which the street is worn. The burned asphalt is then scraped off by hand labor, hauled away in trucks, and discarded. New asphalt is laid on the remaining surface and rolled.

In granite paving operations, before the asphaltic filler is applied, the block is treated with a non-adhering wash, so that the surplus filler can be removed more easily.

For their valuable assistance in supplying statistics, information on Departmental procedure, and photographs, the writer is indebted to Charles J. C. Doherty, Superintendent of Maintenance, Harry W. Levy, Assistant Chief Engineer of Sewers and Highways, and Louis S. Wund, in charge of office records and clerical force.

Flood Control Research for the Susquehanna Valley

The selection of sites and the preparation of designs for a series of dams which eventually will control the flow of water through the entire Susquehanna valley and, it is hoped, eliminate the danger of serious floods therein in the future, is the purpose of intensive studies being made at Cornell University by the War Department, the School of Civil Engineering cooperating. Benjamin K. Hough, Jr., of the U. S. Army Engineer Corps has a staff of 35 men working in Ithaca, N. Y., on problems of soil mechanics; and A. N. Vanderlip with Prof. Ernest W. Schoder and other members of the Cornell engineering faculty are conducting research in hydraulics, making extensive use of the hydraulics laboratory of the college. Also the War Department has erected on the campus a new soil mechanics laboratory, equipped with two carloads of apparatus from the abandoned Passamaquoddy dam project.

The hydraulics research is dealing with problems in channel improvement, construction of check dams and other water control measures; and that in soil mechanics relates to foundations and suitable materials for earth embankments and dams. In connection with the former, a model has been made of two miles of the Chenango river through Binghamton (where disastrous floods occurred in 1935 and 1936) to a scale of 12 inches to 75 feet. Tests, with the model, of results of flood conditions are made on the basis of three different levels of the Susquehanna, since the level of that river, into which the Chenango empties, has important effects on the flood level at Binghamton. Probable effects have thus been learned of a number of proposed channel improvements designed to lower the flood stage in Binghamton at least a foot—a margin which would have had important beneficial effects during both floods. Further lessening of flood hazard must come through control of the Susquehanna and its tributaries nearer the source. Dam sites have been investigated on the Otselic river a few miles above Binghamton and on the Canisteo river above Hornell.

Dams will be built on most of the important tributaries of the upper Susquehanna, most of them of earth; and soil studies are being made with a view to obtaining information relating to stability, permeability, seepage, settlement, angle of slope, etc., of earth dams built of the soils at each place considered.

Effect of Resin on Bituminous Binders

The results of investigations into the influence of resin pastes on bituminous materials have been summarised as follows:—such additions improve the durability, raise the softening point and reduce the liability to oxidation. Both the plasticity and the adhesive power of the binder are somewhat increased. Emulsions containing bitumen-resin mixtures are said to possess properties comparable with those of cut-back bitumens of high quality. The nature of the reaction between resin and tar is now under investigation; the properties of tar-resin mixtures are similar in some respects to those of heavy tars, but the tar-resin products are less liable to ageing, and are as easily distributed as ordinary tars of medium viscosity. Metallic resinates have been used chiefly in conjunction with tars, the properties of which are modified in much the same way as by additions of resin, but to a more marked extent, two parts of resinates being equivalent to three parts of ordinary resin. The proportion of resinates should not exceed 10 per cent.—*Science et Ind.*, Road Abstracts.

The Editor's Page

A City That's Alive Is Never Finished

One of our contributors, telling something of Manhattan's endless job of street maintenance, brings up again the old remark about the city never having been finished. To those of us who dodge excavations and detour piles of construction material almost daily in passing through Manhattan's streets, it is far more than just a remark. Yet the same is true of every city, and of almost every construction job. A city where no underground construction is under way or contemplated is dead—so dead that it doesn't even know it.

The consulting engineer plans and the contractor builds a water works system; and before the dirt has settled in all the trenches, there are extensions to be made. Some of the folks who waited to see for themselves all of the advantages of water supply, have finally made up their minds and more mains are laid. The new sewage treatment plant is no more than in operation when maintenance and additions seem to be necessary. But perhaps this is human nature and not engineering. Even the head of a family, when *she* moves into a new house finds a number of things that need changing. (This being strictly a man's magazine, we feel safe in saying that.)

It is just these necessities for *continuous* construction that makes it worth the while of every city, town, village, county, township or state to maintain an adequate technical staff. When a road system is constructed, it is waste of the crassest sort to neglect skilled maintenance on it—no matter what kind of surface it is. The sewage treatment and water purification plants need trained attendants if they are to return to the taxpayers any dividend in health and convenience. Water mains laid by the unskilled man cost far more in leaks, air locks and poor service than can ever be saved by passing over a good man. Sewers that try to collect all the ground water in the country, or clog, or fail to carry away the sewage contributed to them represent just that much wasted money. Inefficient and wasteful garbage and rubbish collection, and many other jobs of the same type need able and well trained technical men—technical, either through their training or by their experience and judgment, it doesn't make much difference which.

Guaranteeing Pipe Lines

The last few years have seen great advance in the coating of ferrous pipe so great that a manufacturer of coatings suggests the probability that such manufacturers will, in the near future, "furnish a maintenance agreement guaranteeing the freedom of the pipe line from leaks due to corrosion." Lining the inside of the pipe to insure against any action (corrosion, tuberculation, etc.) on the inner metallic surface, by "spinning" on a bituminous enamel, seems to be solved, requiring only proper supervision of condition of pipe surface, heat, etc., during application.

More difficult is protection from soil corrosion as well as physical damage in handling or from soil abrasion or stress. The latter can be effected by wrappings over the coatings, or encasing in concrete in the most serious cases, as where the pipe is to be laid in cinder fills, sea shells or other sharp abrasives, or in certain clays. Soil corrosion is believed to be electro-chemical in action, taking place only where current leaves the pipe. It is possible to bleed from the pipe, at specially prepared points, all the current reaching it along its length so that at all other points the current, if any, passes from the soil to the pipe ("cathodic protection"). If this is done there can not (theoretically, at least) be any soil corrosion. This protection is not very expensive if the pipe coating is good, but may run into a considerable figure if there are numerous current-porous spots in the coating. Also, unfortunately, conditions in city streets are such that it is not generally practicable there, and reliance must apparently be placed on coatings or other protective material.

But apparently a solution is available for any condition and practicable physically, and financially also, with perhaps few exceptions. Millions of dollars loss have been caused by pipe corrosion. All water and soil conditions do not endanger ferrous pipes; but it is difficult to be certain about the exceptions, and pipe insurance would seem to be as financially justifiable as fire insurance.

Sanitation Beyond the Sewer Lines

The article in last month's issue on this subject brought in a number of comments, some of which illustrated the rather hopeless feeling that at least a few engineers incorrectly appear to have about the solution of this problem. In the first place, a well designed and properly constructed small plant should certainly serve an institution, manufacturing plant or residence for 10 to 20 years, which is about the life (without additions or reconstruction) of the average municipal plant; second, the cost should not be out of proportion to the advantages gained. Third, since the effluent from any plant that treats sewage eventually finds its way into a water course, whether this plant be large or small, another of the usual mental hazards can be discounted.

An analysis of this problem from the engineering viewpoint, laying aside prejudices and unfounded beliefs, and putting the same qualities of good design into the solution that would be employed in a larger plant, will greatly clarify the situation.

The American Water Works Convention

It is gratifying for the technically minded man to know that at the New Orleans AWWA convention, something like a round hundred of highly trained technical men will tell "how" and "why" about almost every important water works subject. For those who believe that all work makes Jack a dull boy, it is well to remember that there are plenty of attractions for the tired superintendent or engineer, and that April in Louisiana is a pleasant time for rest, recuperation, reflection—and not too much work. A resume of the highpoints of the trip down, the stopover at Birmingham, and the schedules for the convention week of the 24th to the 28th of April is given on another page.

Why Water Softening Attracts Industries, Promotes Health and Saves Money

By ERNEST EBERHARD

In this article by Mr. Eberhard we give some data, not often available, presented in a manner unusual to this magazine. The purpose is to put into the hands of our readers information on some of the every-day values of water softening in order that they may pass this information on to their communities. The article contains in addition hints on procedure in creating interest in water softening.

DID you ever stop to think that the water supply engineers of a municipality are a major factor in promoting the beauty of its women, the health of its citizens, the efficiency of its plumbing and heating systems, the attractiveness of the town to desired industries, and exercise an almost magic influence over the flavor of its cooking and the spotlessness of its linens? And furthermore, that they can put actual cash in the pockets of every family using the water!

All that—and more, too—is accomplished when water is properly softened. So let us see why water softening is so important a factor in the lives of the population, why a properly softened supply is now-a-days considered as desirable as electric plants and telephone service, and how the average family of five can be saved the yearly tax demanded by hard water.

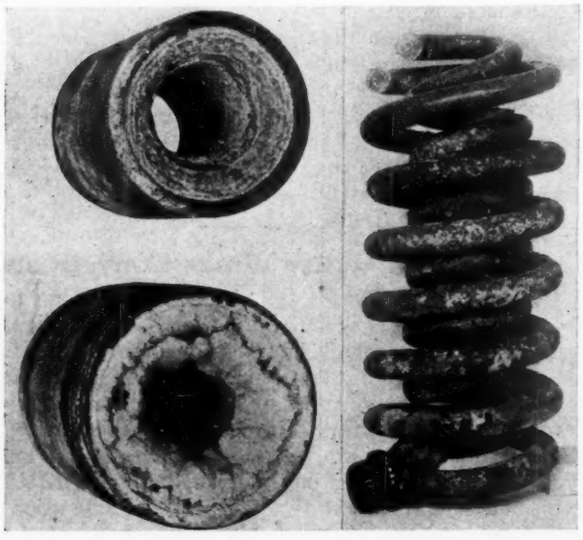
Everybody knows that the sanitation of water has brought about a sharp drop in the number of typhoid cases. But few of us realize that hard water is anything more than a nuisance, any more than people a hundred years ago realized the dangers of the contaminated water they drank.

What makes water hard? The presence of certain minerals such as lime and magnesium. For instance, take an ordinary drinking glass. All that goes into it is plain hard water. Yet when the glass, after washing, is held up to the light, it will be seen to be cloudy from the sticky soap curds deposited and not removed in spite of the glass being carefully wiped with a dish cloth. Glasses washed in soft water will sparkle even when not wiped.

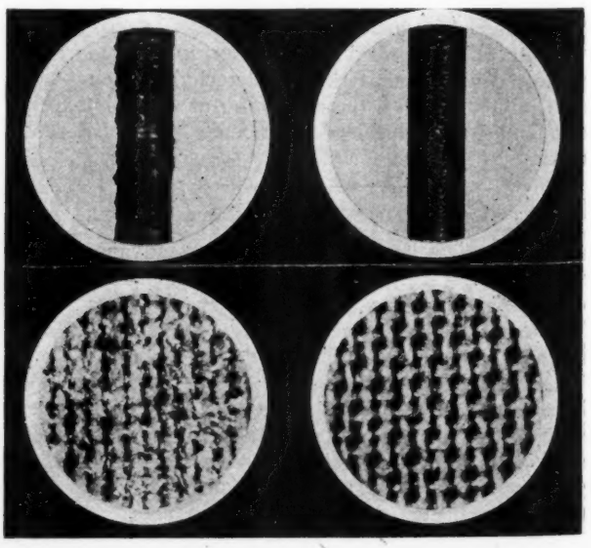
When hard water is heated, mineral deposits are formed on the inside of pipes. One of the accompanying illustrations makes it easy to understand why the gas company in Madison, Wis., has discovered that it costs $5.20 a year for water heater cleaning service when the raw water is used as against $1.25 when soft water is used.

And it also makes it easy to understand why hot water supply pipes will clog up from the minerals in hard water and have to be replaced, or why any container through which hot hard water flows gathers so much scale that, unless cleaned frequently, an appreciable amount of the fuel burned will be wasted because of the scale which acts as an insulator. Many people do not realize that scale has almost the same insulating efficiency as fire brick. According to U. S. Government estimates, if scale on the heating surface is only one-ninth of an inch thick, as much as sixteen cents out of every fuel dollar is wasted. At that rate, a fuel bill of one hundred dollars a year could be reduced to eighty-four dollars with properly softened water. Probably, however, fuel waste due to scale averages about six dollars a year for the average family. In this figure, there is no allowance for overheating and burnouts resulting from the higher temperatures necessary with such a scale.

Another fact worth remembering is that when a pipe clogs up from the minerals deposited by hot hard water, the flow in that pipe is reduced even down to a mere trickle. A quarter-inch scale around the inside of a one-inch pipe will cut its capacity to twenty-five per cent.



Effect of passing hot hard water through supply pipes. **Effect of hard water on hot water heater coils.**



Photomicrographs—Above, human hair shampooed in hard water (left) and softened water (right). Below, cotton fabric washed in hard water (left) and softened water (right).

Of course people washing in hard-water districts know how much more difficult it is to work up a lather, but they are not apt to realize that this greater difficulty means waste of soap, which may be as much as 75%. For instance, per capita soap consumption in Chicago Heights, Ill., is 44.9 pounds compared with 27.5 pounds in Superior, Wis.—which simply means that the hard water in Chicago Heights makes every citizen buy 17.4 pounds more of soap a year than do the folks in Superior, or about eighty-seven pounds more per family. It is probable that the average waste of soap, etc., per family in hard water districts runs around $16.50 a year.

This wasted soap required by the hard water can not be entirely rinsed out even with the greatest care. It remains in the cloth or linens, and melts into the fabric when ironed, thus making the threads more brittle so that they break quicker and the clothes therefore wear out faster. Clothes washed in hard water require more rubbing and stronger soaps—two more reasons why they wear out faster. Also soap curds which can not be rinsed out completely mean accompanying dirt and bacteria, which explains why linens in hard water districts are apt to lack that shining clean, white appearance, and why bright colors lose their brilliancy. The New York State Department of Health says that washing in hard water will reduce the life of clothes by from 20% to 40%, and that although the use of ammonia, washing soda, and various chemicals will reduce the trouble, yet the minerals in the hard water are still present to work harm. It is estimated that hard water will lessen the life of linens, etc., enough to represent $13.50 a year per family.

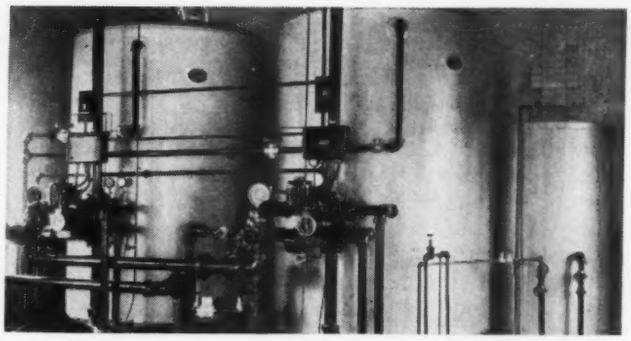
Commercial laundries long ago learned the economies of soft water and the better work that can be turned out.

The same reasons that make it easier to have clean white clothes through washing with soft water also make it possible to have a finer complexion and glossier hair. The sticky soap curds which get into the pores of the skin or surround the strands of hair are no longer present to fill up the pores and cause poor complexions or dull hair. Which is why a beauty shop shampoo will so often prove superior to anything that can be given at home—soft water or special softening preparations are the answer.

With foods, particularly leguminous foods such as peas, beans and lentils, the lime in hard water makes them hard and tough. Canneries have learned the trick of soft water and its influence on flavor and appearance. With coffee and tea, a third less may be required by soft water and the taste is generally held to be far superior. Allowing forty cents a week for these beverages means that savings up to seven dollars or more a year are possible with soft water on these two items alone.

Health, too, is best served by soft water. Many a case of prickly heat is caused by soap clogged pores, and many a beauty specialist in hard water districts will advise against washing the face in hard water because it tends to cause skin blemishes.

Although medical opinion is divided, yet a good many doctors feel that the drinking of hard water under certain conditions may be detrimental. Dr. Thomas Duttin, writing in "The Medical Times," states, "There is little doubt that in certain subjects the constant ingestion of hard water frequently brings on a state of chronic constipation . . . Toxins so absorbed when carried into the blood stream cause various diseases of the digestive system. . . . I have frequently told my patients that they can not be cured of gout, rheumatism, and many forms of indigestion if they continue to drink hard water."



Two "Permutit" pressure softening units at Grafton, Ohio.

The influence of hard water on flavor, appearance and industrial processes, as I have indicated, makes it easy to understand why the relatively soft water of New England and the South has attracted textile industries. The quality of water has frequently been a determining factor in the location of factories, particularly in the days before artificial softening make it possible to have soft water anywhere. A clear, sparkling soft water is always an attraction to industries which use water in their processes—and considering that all must use heat in some form or other, what industry can't afford to take due notice of the water in sections in which it may consider locating, if only to avoid excessive scale in hot water pipes and boilers? Even the vacation industry is affected adversely by hard water, for who wants to spend two precious weeks where the water makes it difficult to shave, wash or to get a decent tasting meal topped off by good coffee.

Of course, in many hard-water districts soft water is supplied by cisterns, which are used in spite of the fact that not a few municipalities have prohibited them because of the poor quality of the water. The bacteria count in the average cistern is high even when filters are used.

The amount of water sold is considerably increased when soft water is made available. So marked is the demand for soft water that there are instances where the amount supplied by the city has increased as much as 250% without increase in population.

Iron in the water, so troublesome in many localities, can be removed when water is softened. Stains from this source are practically eliminated; the cleaner water means whiter clothes.

It seems to me that any engineer whose municipality is handicapped by the hard water problem will realize that the increased importance of a soft water warrants a little missionary work. In undertaking such work, probably the first thing to do is to have a preliminary survey made by an engineer with experience in water softening so that it can be determined exactly what should be done to the water supply, how much a softening plant will cost, and what the cost of operation would be. Such a survey might be made after consultation with the state board of health, which would have to approve any proposals affecting water supply.

After finding out what should be done and the cost thereof, the next step would probably be to talk with the editors of leading local newspapers and explain to them just what water softening means to the city and what the present hard water is costing each individual in actual dollars and cents. A good way to fan preliminary interest into enthusiasm is to borrow a portable

softener. The resulting demonstration over a few days' time should not only sell the editors, but also enlist the support of his family and friends. He can be told to watch the disappearance of the ring around the bath tub, to notice the greater comfort he gets in shaving, how much more sparkle there is to dishes and glassware, the improvement in taste of certain foods, etc. And what all this can mean to the community if everybody has a chance to enjoy it, instead of just those who can afford a hundred dollars or more for a private plant.

With the newspapers' backing and frequent editorials, a foundation of public interest is laid so that it becomes easy to arrange for speakers before the leading local civic organizations such as Rotary, American Legion, etc.

With public sentiment interested, a thoroughly modern water supply system logically becomes part of a betterment program which will attract all those interested in the city's welfare.

Of course the above suggestions are general, as much depends on the type of charter. The cost of a water softening plant may be paid out of revenue, or bonds can be issued. A referendum may or may not be required, depending upon the amount of money involved, the community's charter, etc.

The subject of water softening is so important and far reaching in its effects on the daily life of its citizens and the development of the community as a whole, that it deserves being made into a major issue in any community where hardness is a problem.

Potassium Palmitate Test for Hardness

The need for a rapid and reliable test for determination of the total hardness of a water has long been felt. The three methods given in the current edition of Standard Methods for Examination of Water and Sewage are either too slow or too inaccurate for close and flexible control of water-softening plants. The potassium palmitate test introduced by Blacher in 1913 and used to some extent in Europe seemed promising, but was not sufficiently sensitive for American units of measurement. This method consists of titration of the neutralized sample with a tenth normal alcoholic or alcohol-glycerine solution of potassium palmitate. Calcium and magnesium palmitates are precipitated and at the end point the excess potassium palmitate hydrolyzes to give an alkaline reaction with phenolphthalein (red coloration).

Research by the author indicated that the desired sensitivity could be obtained by use of N/25 potassium palmitate in a glycerine-alcohol solution containing 42% glycerine. A correlation of 7.0 p.p.m. or 2.71 per cent was noted with samples tested concurrently by the calcium-magnesium determination. The test gives hardness due to iron and manganese as well as calcium and magnesium. It is virtually unaffected by the presence of chlorides, sulfates, nitrates and nitrites. Directions are given for procedure, calculations and preparation of reagents.

This is an abstract by P. J. Coffey, for Public Health Engineering Abstracts, of an article by Max Suter in the July, 1927, issue of the Journal of the AWWA.

Municipal Abattoirs in the United States

From a forthcoming report by the International City Managers' Assn. and the American Municipal Assn.

City	1930 Pop.	When Built	Total Cost	Funds Raised by Taxes "T" Bonds, "B"	By What Department Managed	No. of Abattoir Employees	Operating Cost, 1936	Revenue from Fees, etc. 1936
Albany, Ga.	14,507	1916[1]	$37,000	T	Health	3	$7,000	$6,500
Atlantic City, N. J.[2]	66,198	1924	50,000	B	Pub. Prop.	3	4,402	....
Austin, Tex.	53,120	1931	102,000	B	Special[10]	23	33,468	50,154
Baton Rouge, La.	30,729	1915	82,500	B	Finance	9	18,194	10,321
Beaumont, Tex.	57,732	1914	25,000	B	Health	19	29,360	43,550
Bridgeport, Conn.	146,716	1917	11,000	T	Pub. Wks.	8	13,570	26,496
Charleston, S. C.	62,265	1912	85,000	—	Bldg.	13	10,812	16,135
Columbus, Miss.	10,743	1929	5,000	T	Health	3	3,538[3]	1,683
Devils Lake, N. D.	5,451	1916	4,500	B	Health	2	2,297	1,965
Fort Smith, Ark.	31,429	1926	3,000	T	Health	4	3,206	3,524
Greensboro, N. C.	53,569	1925	55,000	B	Health	6	11,398	14,452
High Point, N. C.	36,745	1921	66,444	T	Utilities	4	7,039	8,240
Huntsville, Ala.	11,554	1919	28,000	B	Special[10]	5	7,296	7,758
Logan, Utah	9,979	1935	30,000	[6]	Health	4	7,200	7,200
Meriden, Conn.[8]	38,481	1930	10,000	—	Health	..	....	....
New Britain, Conn.	68,128	1916	30,000[4]	—	Health Bd.	2	5,431[5]	4,460
Paris, Tex.	15,649	1909	10,000	B	Mayor	7	9,284	10,560
Pearl River Co., Miss.	19,405	1937	2,027	—	.....	..	....	....
Raleigh, N. C.	37,379	1913	30,000	B	Pub. Wks.	5[7]	2,852	3,326
Statesville, N. C.	10,490	1937	3,000	T	Sanitary	1	....	....
Taylor, Tex.	7,463	1919	25,000	T	City Mgr.	7	4,210	4,588
Temple, Tex.	15,345	1929	27,000	B	City Mgr.	4	4,928	6,806
Waterbury, Conn.	99,902	1937	50,000	B	Health	2	....	....
Winston-Salem, N. C.	75,274	1935	55,000	B[9]	Health & Finance	11	14,000	24,000

[1] Addition built in 1934 at cost of $11,000.
[2] For slaughter of poultry only.
[3] Cost of entire health department.
[4] Cost of original building in 1916 was $5,000. It was enlarged and refrigerating equipment added in 1926 at a cost of $25,000.
[5] $3,105 for salaries, and $2,326 for maintenance.
[6] Partially financed by WPA.
[7] Part-time employees.
[8] Privately owned plant rented by the city.
[9] Financed in part by PWA grant.
[10] Separate department responsible to chief administrator.

A 2½-mile tangent through the Anagance woods

Bituminous Concrete Pavement Construction Methods

By W. J. LAWSON

Assistant Chief Highway Engineer, Province of New Brunswick

THIS article will give briefly a general description of the current practice of this Province in bituminous concrete pavement construction, together with a description of the preparatory work involved previous to the laying of the pavement.

W. J. Lawson

At present this work is being undertaken on the more heavily traveled main trunk highways in the Province, which, before paving operations commenced, consisted solely of graveled roads, maintained mostly with motorized equipment. The thickness of the gravel surfacing on the existing graveled roads ran from two to six inches, and previous to the start of the paving program very little work was done in preparing the foundation of the highway to receive gravel surfacing.

As a consequence, when we undertook to lay pavement, practically all of the mileage to be paved had to be reconstructed from the foundation up. Too much emphasis cannot be placed on the fact that in order to hold a pavement of any description on any highway, adequate steps must be taken to stabilize the subgrade or foundation. This we have undertaken to do in so far as our finances have permitted us, and, generally speaking, up to the present time we have had very satisfactory results. At the present time we are doing all of this work under contract and our contracts are so arranged that the first year of construction is devoted solely to grading, which involves the preparation of the subgrade changes in alignment, reduction of grades, etc. We are endeavoring to have this work done the first year so that the completed grading project goes through the winter before pavement is placed. This allows for settlement and consolidation of our subgrade which is essential before the actual pavement is placed.

During the second year of the contract any necessary touching up of the subgrade is done immediately before pavement is placed. The contracts are usually completed during the second year, although at times there is a small carry-over in the pavement because of heavy dumps and other sections of the grade not obtaining sufficient compaction. Our contracts are let with an average length of twenty-five to thirty miles and, as mentioned above, are for both grading and paving. We feel that in these long contracts there is sufficient grading and pavement work to be done to warrant a contractor's putting on the job sufficient modern equipment to complete the job in the specified time, and the jobs are big enough to warrant the purchase of sufficient heavy equipment to do the necessary work. This has been proved in our work to date.

Wherever possible our horizontal curvature is held to 5°; our maximum grade is 8%; and we require a minimum of 500 feet of vision over vertical curves.

The first step in our grading operations is the installation of the necessary drainage structures and the taking care of water in our subgrade by lowering the water table. This is accomplished by adequate side ditches and the installation of 6-inch agricultural tile which is placed outside of the pavement edge. These tile trenches are backfilled with porous material. Certain types of soil which do not drain readily have the side ditches constructed, and after the grading is done we place more gravel upon the finished subgrade—any-

Priming finished gravel sub-base.

where from 1½ to 3 feet thickness, depending on how bad this condition is. After the subgrade has been brought to proper cross section, a coating of gravel is placed. This gravel at the present time must be at least 4 inches consolidated depth, and, as stated above, may run as deep as 3 feet.

We endeavor to have the grade of the finished subgrade and gravel base course conform to the pavement grade in that the one parallels the other. After the finished work has gone through the winter, naturally a certain amount of settlement and change takes place.

Priming Procedure

Immediately before pavement operations commence the subgrade is trued up by the addition of gravel to the proper cross section. This usually requires only a small amount of material which is consolidated by traffic and by mechanical rolling. As soon as a sufficient length of grade has been prepared in this manner priming operations commence.

While our pavement is normally 20 feet in width, we require the contractor to fine grade 24 feet width, that is, 2 feet on either side of the pavement edge. This 24 feet is primed.

The following is the specification for the asphalt primer:

(a) It shall be homogeneous and free from water.
(b) Specific Gravity at 60° F., not less than..... 950
(c) Flash Point, Open Cup °F., not less than..... 90
(d) Viscosity at 122° F. (Saybolt Furol) sec.....15-25
(e) Distillation (A.S.T.M. Method D402-34T).

Per cent recovery by volume:

at 374° F., not less than 4
at 437° F., not less than.....11
at 500° F., not less than.....19
Total recovery at 680° F., not more than 40.

Distillation residue:

Per cent by weight, not less than 66
Softening point (B & R) °F., not less than 100
Penetration at 77° F., 100 g., 5 sec., not more than.....200
Ductility at 77° F., cms., not less than.....100
Solubility at air temperature in CS_2, per cent, not less than..99.5

The primer is applied to sub-base material by means of an approved pressure distributor at a rate of not less than ¼ nor more than ½ of an imperial gallon per square yard, at a temperature of not less than 60° F., nor more than 120° F.

(It may be noted here that at times, depending on the grading of the sub-base material, we have had to use more than one-half of a gallon per square yard in order to get a properly primed sub-base.)

Tank wagons, trucks, and distributors used for the transportation or application of the asphalt primer are equipped with satisfactory thermometers for registering the temperature of the material to be applied.

The primer is not applied in wet weather or at temperatures lower than 35° F., or on a wet subgrade, or whenever in the opinion of the engineer the weather or subgrade is not suitable. The primer is allowed to penetrate for such time as the engineer may direct.

The Province furnishes the primer free to the contractor at the nearest railway siding, and the contractor is paid for applying the primer on a unit basis per gallon.

Sufficient primed sub-base is made ready so that approximately a week's traffic will be running over the primed surface before the actual pavement is laid.

Bituminous Concrete Pavement

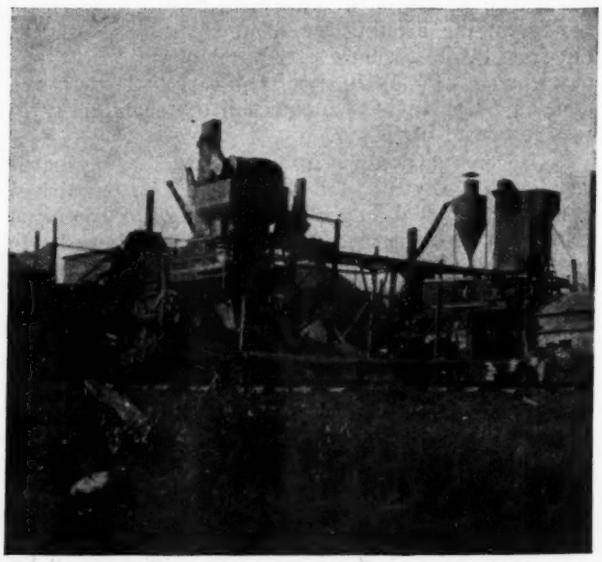
The pavement consists of a base course of densely graded asphaltic concrete to which is applied a surface seal course. The asphaltic concrete base course consists of a mineral aggregate, uniformly mixed with asphalt cement, laid upon the prepared subgrade in the approximate quantity of 330 pounds per square yard, which is practically 3 inches in thickness.

The surface seal course consists of a fine aggregate, uniformly mixed with asphalt cement, and is laid upon the asphaltic concrete base course at the rate of approximately 35 pounds per square yard. The aggregate used in all our asphaltic concrete is crushed gravel, and the coarse aggregate must contain approximately 50% of crushed particles, washed, if necessary.

The coarse aggregate consists of crushed gravel, composed of clean, hard, sound, durable particles, free from flat or elongated pieces, and free from coatings of clay or other material. When tested in accordance with the A. S. T. M. proposed method of test using the Los Angeles Abrasion Machine, as given in the 1935 A. S. T. M. Proceedings, Volume 35, Part 1, Page 350, the coarse aggregate shall not show an abrasion loss of more than 35%. When tested by means of laboratory screens the coarse aggregate shall meet the following grading requirements:

Passing	*Per Cent*
1¼" round	100
¾" square	60-80
⅜" square	20-35
4 mesh	0-5

The fine aggregate consists of natural sand or crushed particles, composed of clean, tough, durable grains, free from objectionable amounts of clay, loam, or other foreign material. When tested by means of laboratory



Typical double-plant mixer set-up of McNamara Construction Co.

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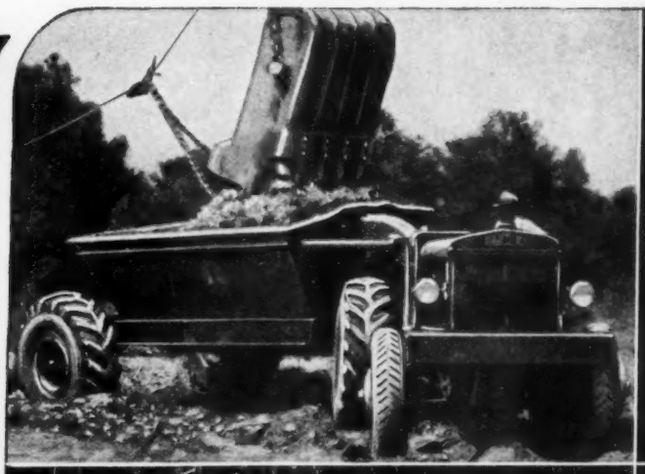

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screens the fine aggregate meets the following grading requirements:

Passing	*Per Cent*
4 mesh	95-100
30 mesh	30- 55
100 mesh	15- 35
200 mesh	6- 25

It may be noted here that the fine aggregate with the above grading is the material used for the surface seal course. It is exactly the same as the fine aggregate used with the base course and is simply drawn off from the required bin when called for.

The coarse and fine aggregate specified above are combined in such proportions as to produce an aggregate graded within the following limits. This combination comprises our base course:

Passing	*Per Cent*
1¼" round	100
¾" square	70-85
⅜" square	50-70
4 mesh	35-55
30 mesh	15-28
100 mesh	7-17
200 mesh	3-12

Composition of Mixtures

The constituents of the asphaltic concrete base course and the surface seal course mixtures are combined in such proportions as to produce mixtures conforming by weight to the following composition limits, and varied between these limits as directed by the engineer:

	Asphaltic Concrete Per Cent	*Surface Seal Per Cent*
Coarse Aggregate	45-65	
Fine Aggregate	30-50	90-93
Bitumen	3.5-5	5.5-10

The asphalt cement used in both the base and top courses conforms to the following specifications:

It shall be homogeneous and free from water, and shall not foam when heated to 175° C. (347° F.).

(a) Specific Gravity at 60° F., not less than.....1.00
(b) Flash Point, Open Cup, not less than.....300° F.
(c) Softening Point (B & R).....80-100° F.
(d) Float Test at 140° F., not less than.....90 secs.
(e) Volatility at 325° F., 50 grams, 5 hours, per cent loss by weight, not more than.....1.0
(f) Ductility: When the material is evaporated to 100 penetration residue, this residue shall have a ductility at 77° F., 5 cms. per minute, of not less than 100 cms., and at 39° F., 1 cm. per minute, of not less than.....10 cms.
(g) Solubility at air temperature in CS_2, per cent, not less than 99.5

The asphalt cement is furnished free by the Province to the contractor at the nearest railway siding to the plant set-up, and the contractor is responsible for any loss in the asphalt cement received and not used.

Complete set-up at Muniac of Dufferin Pav. & Constr. Co. which produced 80 tons per hour. Gravel plant in foreground and mixer in rear.

It may also be noted here that at the present time we are using the asphalt cement with a softening point of 90-95° F., which is in the broad limits of the specification which calls for 80-100° F.

Paving Plants

Plants used for manufacturing paving mixtures are of the batch type, of a size approved by the engineer, and must be provided with separate chambers for drying and mixing the constituents. The coarse and fine aggregates are dried and heated in an approved type of revolving drier, equipped with a registering pyrometer at the discharge chute. The aggregate materials, on being discharged from the drier, must be in a surface dry condition and shall not contain sufficient moisture to interfere with the proper adhesion of the bitumen to the aggregate surface.

After leaving the drier all hot aggregate is passed over a screen so as to separate it into not less than two sizes. The screens are of such size and capacity that the dry aggregates are effectively separated into the specified fractions, none of which shall contain more than 5% of particles which should properly belong to the other fraction or fractions. The hot aggregate discharges from the screen into a separate storage bin for each size, bins being so constructed as to prevent overflow of one size into a bin used for another size. Each compartment is equipped with a tell-tale overflow chute of such dimensions that it will not block through bridging of aggregates. Each bin compartment is equipped with a discharge gate located directly over the weighing hopper, gates of both bins and hopper being so constructed as to prevent leakage when they are closed.

The weighing hopper must have sufficient capacity to hold the maximum amount of aggregate for one batch. Scales for the weighing hopper are either of the dial or beam type. If of the beam type, they are equipped with a precision indicator and are sensitive to ½ of 1% of the maximum load that is required. When of the beam type, there must be a separate beam for each size aggregate and a tare for balancing the hopper.

The asphalt bucket for weighing the asphalt cement must have sufficient capacity to hold not less than 10% of the batch weight. It is suspended on dial scales so arranged that any deviation from the net tare weight of the bucket shall be shown for each weighing. The graduations of the dial are in increments of 1 pound, and the scale must be sensitive to at least one-half of this amount. The bucket delivers the asphalt cement to the aggregate in the mixer box in such manner that after mixing for the specified period of time, the bitumen content of samples drawn from different parts of the batch will not differ by more than 0.2%.

All plant scales are tested by the proper authority at the contractor's expense, and the customary certificate exhibited to the engineer at his request. If considered necessary, these scales are retested at the contractor's expense.

Melting kettles and hot storage tanks which deliver asphalt directly to the weigh bucket are equipped with thermometers and means for positive control of asphalt temperature at all times. Steam-jacketed lines and connections are provided for the transportation of asphalt from kettle to mixer, if necessary, to insure the prompt and continuous delivery of asphalt cement at the specified temperatures.

The mixer is of the twin shaft pugmill type or of the rotary type, in which the asphalt is sprayed into and incorporated with the mineral aggregate. The mixer is so constructed as to prevent leakage of contents until the batch is discharged. If required, the mixer must be equipped with a lock timing device, satisfactory to the

PARKS FOR KENOSHA

On a 500-foot haul in Alford Park, Kenosha, Wis., this International TD-40 Diesel TracTracTor and 3½-yard scraper move close to 400 yards of dirt in 8 hours.

Two beautiful parks, with extensive bathing beaches on Lake Michigan, will be ready for the citizens of Kenosha, Wis., to enjoy this Summer. Southport Park covers 45 acres at the south limits of the city and Alford Park at the north end is a rolling 155-acre tract.

• With the aid of an International TD-40 Diesel TracTracTor, work is progressing rapidly on these developments. Park officials purchased this economical crawler tractor a year ago, assigning it to Southport Park for several months and then transferring it to Alford Park to move dirt with a 3½-yard, 2-wheel scraper.

• Much of the International TracTracTor's work at Southport Park was in the water, often to a depth that covered its tracks. Concrete blocks for jetties, which were built to form a beach, were put on the ice during the winter. In the Spring, many of them were submerged. The International maneuvered these heavy blocks around for a crane to pick them up. It also pulled trees, hauled loaded gravel wagons through soft sand, and moved heavy construction equipment.

• An important share of the dirt-moving job at Alford Park is being done by the International TracTracTor with the scraper. Operating on a 500-ft. haul, this combination moves 300 to 400 yards every 8 hours in clay and muck. Excavation for three artificial lagoons will require the tractor handling 28,000 yards of dirt. Following this job,

At Southport Park in Kenosha, the International Diesel TracTracTor spent much time partially submerged in Lake Michigan hauling out concrete blocks—a striking testimonial of the value of TracTracTor construction which keeps oil in and water and abrasives out of all working parts.

4½ miles of walks and bridle paths will be built, and other fill-in and grading work will be done.

• The proof of International Diesel TracTracTor's performance and economy comes out on the job, as Kenosha park officials know. Find out from our nearby Company-owned branch or International industrial power dealer how International Diesel TracTracTors and Power Units can solve your power problems.

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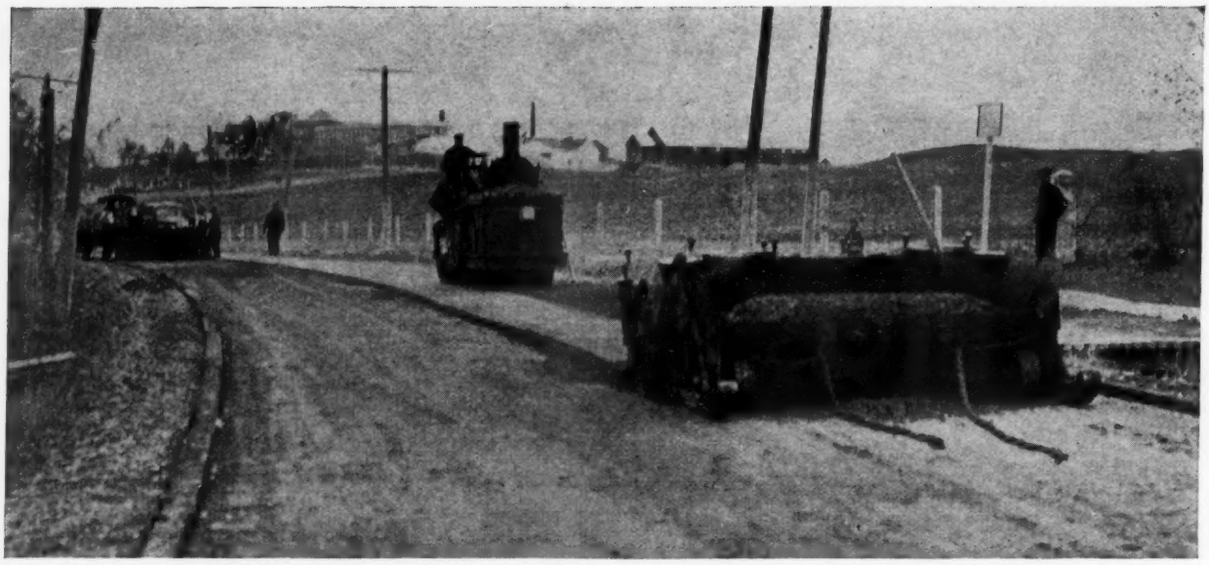
Turn to Pages 55-57 for descriptions of helpful booklets and catalogs.



Base being laid near Dorchester with Jaeger Spreader (not self-propelled). Work by Rayner Construction Co.

engineer, by means of which accurate control of the mixing cycle may be maintained.

The asphalt cement is heated at the paving plant to a temperature of 150° F. to 225° F.

The coarse and fine aggregates are dried and heated at the paving plant so that when delivered to the mixer they are at a temperature of 175 to 250° F., as directed by the engineer. Both coarse and fine materials may be fed simultaneously into the same drier, but, in such case, immediately after heating they are screened into fine and coarse aggregate and stored in separate bins. Aggregates must be surface dry when delivered to the mixer and at this point shall not contain moisture in excess of the following:

Coarse Aggregate: not more than 0.25%
Fine Aggregate: not more than 0.5%

Preparation of Mixtures

Base Course—Each size of dry aggregate and the asphalt cement is measured separately and accurately by weight for each batch to be mixed. After the dry aggregate has been charged in the mixer the asphalt cement is added and the mixing continued for a period of at least 45 seconds, or longer, if necessary, to produce a homogeneous mixture in which all particles of the mineral aggregate are coated uniformly.

Surface Seal Course—The fine aggregate and the asphalt cement are measured separately and accurately by weight for each batch to be mixed. After the dry aggregate has been charged into the mixer, the asphalt cement is added and thoroughly mixed for a period of at least 1 minute, or longer, if necessary, to produce a homogeneous mixture in which all particles of the mineral aggregate are coated uniformly.

For the verification of weights or proportions and character of materials, and determination of temperatures used in the preparation of the mixtures, the engineer or his authorized representative has access at any time to all parts of the paving plant.

Construction Methods

Both base and seal courses are transported from the paving plant to the work in tight vehicles, previously cleaned of all foreign materials, and when directed by the engineer, each load is covered with canvas or other suitable material of sufficient size to protect it from weather conditions. The inside surface of all vehicles used for hauling mixtures is lubricated just before loading, but excess of lubricant is not permitted. No loads are sent out so late in the day as to interfere with spreading and compacting the mixture during daylight, unless artificial light satisfactory to the engineer is provided.

The base course mixture is laid only upon a subgrade or sub-base which is dry, or at least free from standing water, and only when weather conditions are suitable. This applies also to the surface seal course placed on the base course. Prior to the delivery of mixtures on the work, the prepared sub-base must be cleaned of all loose or foreign material. Neither of the mixtures is allowed to be laid when it is raining, and except by permission of the engineer, no mixture is laid when the air temperature is below 35° F.

If, at the time of laying the base course, permanent side supports, such as curbs, edgings or gutters, have not been constructed, suitable side forms of wood or steel are firmly fastened in place, true to line and grade. These forms remain in place until reasonable compaction has been obtained and the mixture is sufficiently stable to resist lateral displacement under further rolling. Immediately after the forms are removed and before any further rolling is done, approved shoulder material is placed against the finished edge. The final compaction of both shoulder and pavement is obtained by continued rolling.

The base course mixture is deposited from the truck directly into the spreader box attached to an approved self-propelled paving and finishing machine. This spreader box is equipped with a mechanically operated raker bar having teeth capable of thoroughly agitating and mixing the mixture as it is being spread on the subgrade. The mixture is also allowed to be deposited from the truck directly into the spreader box attached to an approved spreading machine, not self-propelled, which is capable of spreading and bleeding the material over at least one-half of the width of the pavement area. We do not allow the use of a spreader box alone, nor do we allow hand spreading. We have found that the use of the spreader box alone plus rakers does not give us as good results as the spreading machine, due to the fact that in spite of all precautions segregation of the material in the pavement surface resulted from the use of hand work. After the spreading machine has passed, the surface of the mixture must be smooth and true to

cross section, free from all hollows, irregularities and segregated areas and of a uniform density throughout.

The placing of the base course mixture is as continuous as possible. Where traffic is not diverted from the section under construction, the pavement is laid in two strips, each one-half the full width of the pavement, the two strips being carried forward in alternate stretches as close together as possible in order that the material of the second strip may be bonded to that of the first along the centre line of the pavement, thus preserving the proper bond and contour of the whole.

Immediately after spreading, the base course is given a preliminary rolling with a power-driven tandem roller. We do not specify the weight of this roller but our experience has been that we get the best job by using a roller weighing from 5 to 8 tons, thus giving the base course a light initial compaction just previous to the spreading of the surface seal course.

As soon as possible after the base course has been given the preliminary rolling, and when this course will bear the weight of the roller without undue displacement, the surface seal course is spread uniformly thereon at the rate of from 30 to 40 pounds per square yard. Satisfactory uniformity of distribution can be secured with an experienced operator casting the material from shovels over the pavement surface in a direction longitudinal to the pavement. Lutes or rakes are then used to even the material and to smooth it up. Immediately following the spreading of the surface seal course, the rolling is continued with a power-driven three-wheel roller weighing not less than 10 tons. We do not permit traffic over the base course or the seal course until it has had a preliminary rolling. The seal course is placed while it is hot on the still warm base course and is rolled into and becomes an integral part of the pavement. Probably about one-third, on the average of the total seal course, is rolled into the base, so that it is practically impossible, if laid properly, to peel off.

As stated before, the initial rolling of the base course is carried out with a power-driven tandem roller. All of the other rollers required on the work are power-driven three-wheel rollers, weighing not less than 10 tons. Rolling starts longitudinally at the sides and proceeds towards the centre of the pavement, overlapping on successive trips by at least one-half the width of the roller wheel. Alternate trips of the roller are of slightly different lengths. As directed by the engineer the surface is given a second rolling not sooner than 24 hours after the initial rolling, and when necessary rolling is continued from day to day until there is no displacement of the surface. It is just previous to the back rolling that the forms are removed and shoulder material placed against the pavement, when about one foot in width of the shoulder is compacted in conjunction with the pavement. The speed of the roller must not exceed 3 miles per hour and is at all times slow enough to avoid displacement of the mixtures. Rolling proceeds continuously at a rate not in excess of 20 tons per hour per roller and continues until all roller marks are eliminated and no further compression is possible. Where more than the stated amount per hour per roller is being laid, additional rollers are required.

The surface of the finished pavement must be smooth and true to the established crown and grade and must present a surface of uniform texture with no evidence of segregation or insufficiently sealed areas. Its average thickness is from 3.1 to 3.25 inches and at no point is less than 2.87 inches in thickness. The surface is free from depressions exceeding ¼ of an inch as measured with a 10-foot straight edge paralleling the centre line of the roadway. Payment is made to the contractor on

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They alone combine the following desirable features:

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Many of these reasons are explained in Catalog No. 37P. Your copy will be gladly mailed upon request.

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and
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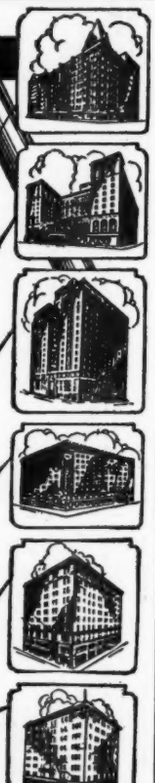

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"Genuinely Friendly"

a tonnage basis for both the base and seal courses and the contractor is obliged to provide and install an approved truck scale at a location convenient to the asphalt plant. The Department of Highways provides a weighing checker for this material.

General

We consider that the plant-mixed surface seal course which we are using is much more durable than a seal coat using a liquid bitumen and cover coat of chips, etc. Some of our contractors are not very partial to this use, because the manufacture of the seal coat slows down production in the plant. To offset this several of our contractors are using two asphalt plants per job, one plant attending mainly to the manufacture of the surface seal course, while the second plant is working continuously on the manufacture of the base course.

We consider that our plant-mixed aggregates, in both base and seal, using dry materials, are much superior to other types of bituminous pavement construction because we have accurate control of the grading of our aggregates and our bitumen content. This is obtained by rigid plant and street inspection, which is done for the Province by an independent inspection company employed to do this work. Samples of the various mixtures are taken periodically and tested, both for grading and bitumen content, to see that they conform in all respects to our specifications.

We have adopted the use of the soft type of asphalt cement we are using in order to minimize the amount of cracking which takes place in asphaltic concrete pavements when a harder type of paving asphalt is used. Our soil and climatic conditions are such that it is almost impossible to get away altogether from a certain amount of frost action in the foundation of the road no matter how careful we are with our preparatory work. We feel that the use of this softer type of asphalt allows for a more flexible pavement and one which gives more readily under the action of frost.

The following is a list of equipment used on any of our paving contracts. This equipment applies only to the laying of the pavement:

One or more pressure distributors
One or more three-wheel rollers for fine grading, with scarifier attachments
One tandem roller.
One to six three-wheel power-driven ten-ton rollers, depending on the amount of pavement being laid per hour
Forms
One or more self-propelled finishing machines
or
One or more finishing machines towed by trucks
One or more standard hot-mix asphalt plants with the necessary storage tanks, etc., for storing and heating bitumen.
One or more crushing plants for crushing of aggregates
Truck scales
The necessary trucks, small tools, etc., needed for the output of the plant
Other equipment necessary for the operation of the asphalt plant are steam or gas shovels, conveyors, cranes, etc., used in and around the plant.

Our paving program was started in the late summer of 1934, and at the present time we have approximatelv 520 miles of pavement completed. At the end of the 1938 season we will have paved approximately 825 miles. This mileage includes about 40 miles of pavement through incorporated towns and cities.

Rejection of Lowest Bid Arbitrary Where Bidder Financially Responsible

The New York Appellate Division, In re Fuller Const. Co., 231 App. Div. 174, holds that the rejection of the lowest bid (under Town Law §234) and the acceptance of that of the second lowest bidder merely as

being in the best interests of the sewer district, and without a valid basis for such action, is arbitrary. In this case the lowest bidder was shown to be financially able to carry out the contract. It posted a certified check for $30,000 to insure (1) its execution of the contract if awarded to it, and (2) that it would furnish a surety company bond to insure completion. It was also shown to have had greater experience in performing the type of work required by the contract than the second lowest bidder had.

Surfacing Old Stone Paving

Sett paving which has become thoroughly consolidated was used as paving foundation in Berlin. The treatment varies according to the character of the surfacing. In all cases the joints are given careful preliminary cleaning. Where the setts were laid in concrete, and where the joints were open to a considerable depth, a priming coat of high-viscosity bitumen emulsion was applied; the joints and any uneven places were filled with fine chippings. The emulsion was then spread at the rate of 5½ lb./sq. yd. and swept into the joints; fine chippings were applied at the rate of 26 lb./sq. yd. and rolled.

A second stretch of similar type received a priming coat of binder (a hot cut-back tar) after which the joints were filled and any irregularities corrected; chippings were applied in two stages, at a total rate of 4 lb./sq. yd. Finally, tar was applied at 3.7 lb./sq. yd. On surfacings consisting of cobbles or large setts, the chippings were applied before the binder. The latter consisted of cut-back tar, cold tar, cold tar mixed with 15 per cent of bitumen, or bitumen or tar-bitumen emulsions.

Hot tar was usually applied by means of a spraying machine, cold tar or emulsions from cans. The aggregate was applied either in two or three stages, at a total rate of 46 to 59 lb./sq. yd. In all cases excess material was swept off. The joints were finally sealed after an interval of some months. Satisfactory results were obtained throughout. On other sett-paved roads, thin carpets of tarred stone chippings were provided. A light dressing of hot tar was applied to the cleaned sett paving and the chippings were then spread at the rate of 64 lb./sq. yd., levelled and rolled. In some cases, the treatment was applied over the central 13 ft. 6 in. of the street only; the joints between the setts on the remainder of the street being carefully filled with tarred chippings. By H. Kroecker, Verkehrstechnik, 1937, in *Road Abstracts*.

Modern Garbage Collection Unit for Pontiac

A special dump body is used on garbage collection units of the city of Pontiac, Mich., replacing an open-type body with tarpaulin covers. The new unit has low loading and fully-enclosed water tight body. It hauls 2¼ tons of garbage and is mounted on a 3-ton truck. There is a loading hopper at the rear of the truck which has a capacity of ¾ yard of garbage. This is lifted hydraulically to the top of the body and dumped. When unloading, the entire body is raised to a 70° angle and the load discharged through large rear door.

Two men work with the truck while loading. About three trips are made per day to the incinerator located in the east side. This new unit has been employed mainly in the downtown section, and has proved satisfactory, so that other equipment will be modernized. Lewis M. Wrenn is city engineer.

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Smoothly Spreads Stone, Macadam and Bituminous—1" to 10" of Loose Material, 8 to 11 Ft. Widths.
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6 Sizes from 5 to 12 Tons Gasoline or Diesel.
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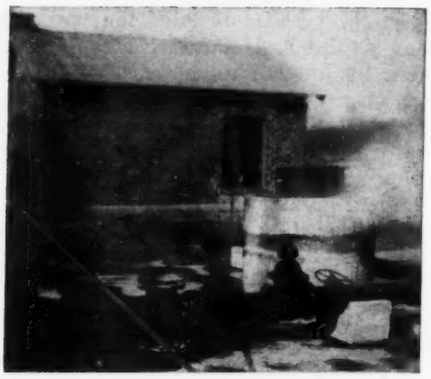
Turn to Pages 55-57 for descriptions of helpful booklets and catalogs.

A New Disposal Plant From an Old Septic Tank

By G. M. Bassel
City Engineer, Maryville, Tenn.



Foreground, gas dome on digesting tank, and sludge pipe. Pump house in background.

FOR about eighteen years the 15″ trunk sewer from the City of Maryville, Tenn., discharged into a concrete septic tank about 25 ft. x 80 ft. in plan, 9 ft. deep. The effluent from the tank, which probably included much sludge, passed directly into a creek.

At irregular intervals, averaging about three years, the sludge was cleaned out of the tank by means of a portable, gasoline-driven, diaphragm pump. This was a disagreeable job, necessitating much scraping and flushing, the bottom of the tank having only a slight slope. The sludge was pumped into a pit excavated in the earth near the tank, whence the liquid drained off into the creek, soaked into the ground, or evaporated. Some of the sludge was, of course, only partly digested, but the odors arising from the pit did not cause so much complaint as might have been expected.

However, about two years ago the mayor and commissioners decided that a more satisfactory method of disposal was needed and that it would be desirable to construct the plant while federal aid was available.

In designing the plant three principal results were to be sought:

1. Low cost of construction and operation.
2. Treatment adequate to avoid serious offense to the eye or sense of smell and that would receive the approval of the State Health Department.
3. Capacity sufficient to take care of a considerable increase in the number of sewer connections.

Pistol Creek, into which the tank discharges, is fed by a number of large springs, affording at all times a considerable flow of water for dilution, and it was decided that for the present primary treatment only would be sufficient. However, more land than is now needed was purchased, so that when it becomes necessary, the treatment may be extended.

In order to help in the attainment of the first object, it was planned to make use of the old septic tank, after making certain changes to adapt it to its new use. A concrete wall and influent trough was built across the old tank near the middle, dividing it into two compartments of equal length, one end to be used for settling tanks, the other as a sludge digestion chamber.

The old tank had a flat reinforced concrete roof, and this slab over the part to be used for settling tanks was nearly all removed, enough being left to provide a platform at one end for operating the four sludge pipes and to support the motor which operates the sludge-removing apparatus. This part of the old tank was divided by a longitudinal wall into two sedimentation tanks each 11′ 5″ wide. The bottom of the tank was covered with new concrete which slopes 1″ in 10 ft. toward the sludge hoppers, four of which, 2′ 6″ deep, were built at one end, each with its vertical valved sludge pipe. The water depth of these tanks is 6½ ft. Rails were built in the bottom concrete for carrying the sludge conveyors.

Just before entering the settling tanks the raw sewage passes through a screen chamber, in which are ½″ x 2″ iron bars spaced 1″ apart. The screenings are removed from this daily by means of a garden rake and buried.

In the other end of the old tank, adapted for use as a digestion tank, practically all of the old bottom was removed and four hoppers built, each 11 ft. wide and 16 or 17 ft. long on top, 3 ft. square on the bottom and 7 ft. deep. The old roof was retained, with its manholes, which extended about 3 ft. above the slab. Two of these were built about 8″ higher and fitted with steel gas domes. It was not intended to collect the gas for heating or other useful purpose at present, but it was thought that by burning it in a waste gas burner offensive odors might be lessened. However, collection of gas thus far has not been very successful, as cracks in the old roof permit the escape of much of the gas; also the flat roof is unfavorable to its collection.

An open sludge drying bed was constructed with the usual type of filtering material and underdrains.

A pump house was built, with a sludge pump set in a pit low enough to make it self-priming at the beginning of the pumping; space being provided for another or larger pump when needed; also for a small laboratory. However, at present the plant is being operated without equipment for making many tests or keeping daily records. The one sludge pump transfers sludge from the sedimentation tank hoppers to the digestion tank, and from this tank to the sludge drying bed.

The work of tending the motors and pump is done by one man who ordinarily is kept busy about half of each day. The fresh sludge is pumped from the settling tanks twice a day, morning and evening.

The sewage is almost entirely domestic, only a little being contributed by industries. It is estimated that about two-thirds of the residences in town, which house about 5,000 population, are connected with the sewers. A considerable length of the trunk sewer is near the creek, below high water level, and during wet weather there is much infiltration of ground water.

Starting with a clean tank and fresh, unseeded sludge, it was expected that the process of digestion would be slow at first. But it has been slower than was anticipated.

Some of the dried sludge is being used for fertilizer. The remainder will be used in filling low places.

The work was carried out as a PWA Project. Contractors were invited to submit bids for the construction of the plant as a whole, but no bids were received and the city was authorized to proceed with the work by force account under the usual PWA regulations. The entire cost, exclusive of land purchased, was about $17,000.

The treatment plant was designed by the writer, who also supervised its construction.

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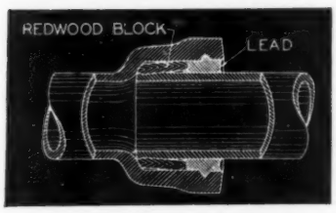

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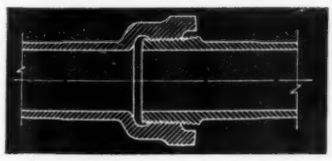

the only *intermediate* joint that does not restrict internal diameter — the only joint as strong as the pipe itself. Only McWane can furnish long 18 ft. laying lengths with only *one* intermediate joint!

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McWane 2" *cast iron* pipe gives your small mains the same ability to resist corrosion—the same permanence—the same 100-year security against high pumping costs, leaks, losses, replacements. And—here's a surprising fact—this *permanent* pipe costs only a few *pennies* more per foot than a short-lived substitute! Investigate!

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Chicago, Dallas, Denver, Kansas City, New York, Portland, Ore. Salt Lake City, San Francisco, Los Angeles.

A Five-Million-Gallon Well for Savannah, Ga.

A well has been drilled 613 feet deep to provide water for the city of Savannah, Ga., which on test produced approximately 5,000,000 gallons a day. A 22" casing was set to a depth of 240 ft. and cemented from top to bottom on the outside to prevent any possible contamination from surface waters. Most of the 613 ft. was drilled through solid rock. The softer formation, from which the greater part of the water is obtained, was under-reamed to a diameter of 26". Approximately 70 ten-hour days were required to drill the well and install pumping equipment, using a Layne-Atlantic well drilling outfit powered by two Hercules DJXC Diesel power units, which consumed 75 cts. worth of fuel oil per day.

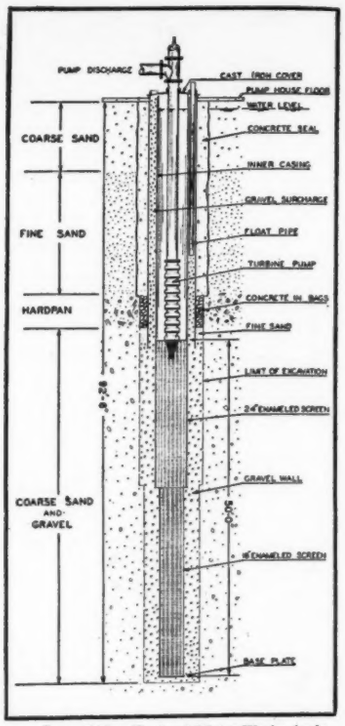
Stealing a Buried Water Main—Another Problem for G-Men

On the morning of January 16th, thirty consumers telephoned the office of the Miami, Fla., Water Department, complaining they could get no water from their faucets. It had been flowing the night before, but that morning—not a drop. Hurried investigation showed that not only was there no water—there was no pipe to bring it. During the night some men with a queer sense of humor or a pressing need for pipe had dug up and removed 460 feet of 2½" main. Such, at least, is the statement of the Miami *Herald*. Water mains do not have to be buried very deep in that southern city, but neither is the native worker very energetic; so we wonder.

Following is a digest of the important articles published last month having to do with water works design, construction and operation and water purification, arranged in easy reference form.

The Water Wheel

Well supplies possess the advantage that the danger of pollution is generally less than with surface water, evaporation and leakage losses can be ignored, condemnation of land is negligible, and cost of development is usually much less than that of impounding reservoirs of comparable yield. But a thorough search for a favorable site is very important; watershed area is important, underground storage in large volume is necessary, and most important of all is the permeability of the material conducting the water to the well. The best type of well depends on the depth and nature of the water-bearing strata and the desired draft. If the only available aquifer is thin over relatively impervious material, water must be collected from many points. If there is a deep deposit of coarse material, a well is desirable that will utilize the available hydraulic capacity. This last was the condition found at Needham, Mass., there being 80 to 100 ft. of coarse material above a rock floor, and to utilize this advantageous condition a gravelpacked well not less than 60 ft. deep was specified in bids asked for. The bidders were asked to guarantee the drawn-down when pumping 1 mgd, with a bonus of $300 per foot of drawn-down below the guarantee ($600 maximum). The Layne-Bowler Co. guaranteed a 5 ft. drawndown, but the well required only 2.6 ft. Guarantees of the Fairbanks-Morse Co. for diesel power with turbine pump showed this cheaper than electric, and these also were exceeded, the cost of pumping 1 mgd against 272.5 ft. head being $3.95 per mg with fuel oil at 5 cts. per gal.[B9]



Section through Needham gravel packed well.

Journal New England Water Works Ass'n.

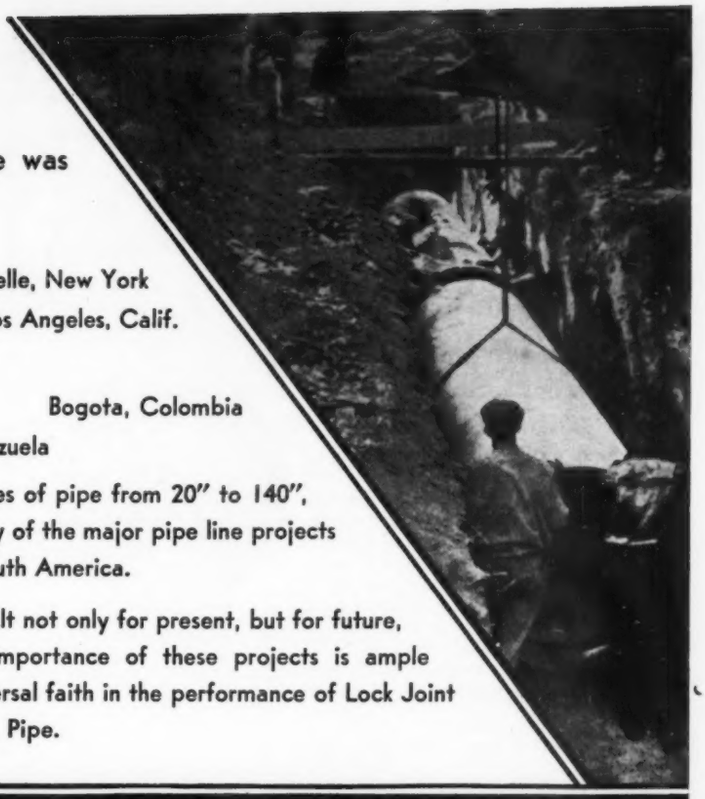
Cathodic protection of 70.36 miles of 61" to 65" steel pipe of the Mokelumne Aqueduct cost $85.11 a mile, of which $25.47 is interest and depreciation on the cost of the equipment ($170), $19.13 is annual power cost and $40.51 is maintenance and tests. It is estimated that this protection has increased the probable life of the pipe from 35 yr. to 70 yr., thus decreasing the annual depreciation and sinking fund from $1607 to $245; an annual saving of $1362 at a cost of $85.11. However, only a fraction of 1% of the area of the steel pipe is exposed by cracking of the covering (bituminous dip coat with spirally wrapped felt covering); if the whole pipe were exposed the cost of cathodic protection would be prohibitive; many times the cost of a concrete gunite jacket (estimated at $8700 a mile) which would have given complete protection.

In installing cathodic protection, a potential difference of 300 millivolts of soil above pipe was considered necessary. For anodes, 20 ft. lengths of 2½" steel pipe, driven vertical into the soil, were used at first; later, 8" holes packed with carbon were used, as the pipes were consumed by corrosion in a few months. To boost the flow of current, 2 hp motor generator sets were used for 4 large stations, several vacuum tubes of 6 and 12 amperes capacity, and one 15 ampere silenium type rectifier which has proved superior. The rectifier stations are visited daily by patrolmen and current and voltage noted. The current drained from the pipe has averaged 250 amp., or 3.1 amp. per mile of protected pipe.[B35]

Leak detecting in Cicero, Ill., is performed by a specially trained crew of 2 engineers and 6 assistants, which regularly makes district surveys of underground pipe lines, while a master plumber examines all inside piping, plumbing and meters. These surveys include inspection of all valves, hydrants and service pipes. Each of the eight major districts into which the distribution system is divided is so valved that one line may feed it, and the water made to pass through a meter in entering it. First, a reading is taken every minute for 24 hours. and decision made whether a leakage survey of the district is desirable. Valves are so placed that each major district can be divided into 2-block to 4-block sections, a 1" tap being placed on each side of each valve and the water bypassed around the valve through a 2" meter, and all service lines being closed at the curb stops. Leakage is located by use of aquaphone and geophone. Of the leaks located, 85% are on service lines and 15% on mains. Meters up to 1½" are tested regularly every 5 yrs. or sooner if the quantity passed has exceeded a certain minimum; meters 2" and larger are tested annually.[B33]

Bacterial pollution of streams seems to have no close and certain correlation to populations on their drainage areas, is the conclusion from study of data collected by the U. S. Public Health Service. This conclusion raises the questions: "Is the coliform organism content of an unpurified surface water a reliable quantitative index of the sanitary hazards connected with its use, or is the density of population, sewered or unsewered, upon a drainage area more reliable? Can the establishment of bacterial standards for purified and unpurified water be based upon sound principles of fact?"[A22]

During 1937



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THESE pipe lines were built not only for present, but for future, generations and the importance of these projects is ample evidence of the universal faith in the performance of Lock Joint Concrete Pressure Pipe.

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High Powered Portable Emergency Generator Set

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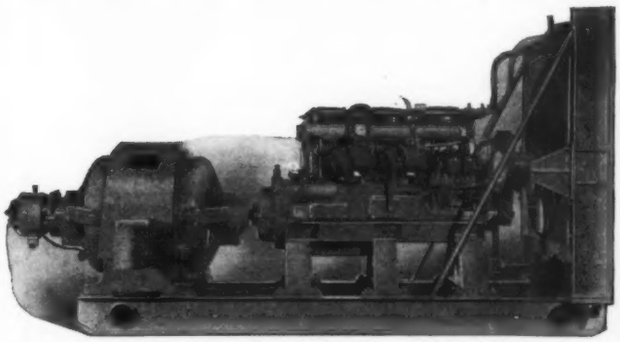

150 Kilowatt, 1800 R.P.M. Emergency Generator Set. Sterling Dolphin 6-cylinder, 240 H.P. engine, direct connected to General Electric Generator, for portable emergency work. Built for Philadelphia Electric Company. Weight—11,160 pounds, as illustrated. Close governor regulation.

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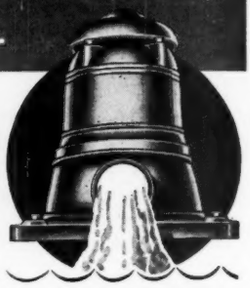

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Protecting the water supply of Portland, Me., from pollution by residents, campers, etc., is being effected by enticing them to a near-by site. The source of supply, Sebago lake, has a water surface of 46 sq. mi.; capacity equals total water consumption of all New England for a period of more than five years. Portland Water District owns 98% of the shore line within 2 miles of the intake, but beyond this are 528 cottages, 14 summer camps, 7 summer hotels, 5 stores and 2 public bathing beaches; temporary camps without proper sanitary equipment and roving campers are especially serious menaces. Recently an ice company sold some ponds to the district which are outside this watershed, and, with WPA assistance, they are being developed for public recreation, winter and summer — a stadium, tennis courts, picnic grounds, roads and trails, sandy bathing beaches, trailer camps and overnight camp sites are among the attractions to divert people from Sebago lake.[B2]

Meter repairing by the Utica, N. Y., water company to secure a registration of 90% minimum at ¼ gpm is facilitated by use of special gauges sensitive to .001 inch; two micrometers, one to gauge the diameter of the disk ball, and one to gauge the diameter of the disk plate; an instantaneous reading gauge to measure the radius of a measuring chamber at any point on the inner circumference to .001 inch; a feeler gauge reading from .001 to .15 inch, used as an additional check in determining the clearance between the disk plate circumference and the measuring chamber walls; 2 micrometers 1″ to 2″, and 3″ to 4″; and a thickness gauge. The clearance between disk and chamber should be .001 inch. The use of these is so successful that the superintendent is "seriously considering raising the test requirement at a quarter of a gallon per minute flow to 95%."[F11]

Manganese in water at Larchmont, N. Y., coated the sand grains of the filter, forming "a contact catalytic mass in the sand beds," which reduced the manganese in the water from 0.8-1.0 ppm to 0.15-0.20 ppm. It was therefore decided not to replace the sand or try to remove the manganese coating. In a laboratory test of the sand it was reactivated with a strong solution of sodium hypochlorite and reduced 10 ppm of manganese in the water filters to less than .05 ppm. The manganese coating does not substantially increase the specific gravity of the sand or hamper the filter washing.[F16]

Bibliography of Recent Sewerage Literature
The articles in each magazine are numbered continuously throughout the year, beginning with our January issue.

c, Indicates construction article; *n*, note or short article; *p*, paper before a society (complete or abstract); *t*, technical article.

A *Journal, American Water Works Assn.*
January

32. Financing Water Main Extensions. By L. A. Jackson Pp. 1-9.
33. Reducing Unaccounted-for Water. By F. J. Broz and G. Diamond. Pp. 10-14.

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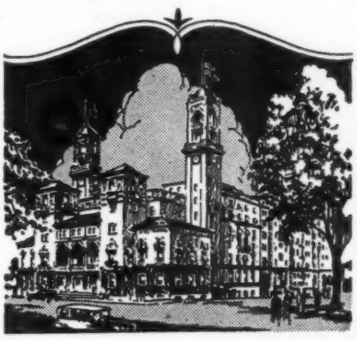

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35. Cathodic Protection of the Mokelumne Aqueduct. By H. A. Knudsen. Pp. 38-55.
36. The Birmingham Industrial Water Supply. By A. C. Decker. Pp. 56-66.
37. Raw Water Supply of the Ford Motor Co. By W. W. Dulmage. Pp. 67-77.
38. Licensing of Plant Operators and Superintendents. By E. R. Stapley. Pp. 78-84.
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40. Operating Kinks. By A. R. Todd. Pp. 112-120.
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45. Nova Scotia Water Supplies. By R. D. McKay. Pp. 152-159.
46. Water Works Systems of the Maritimes. By J. A. Macmillan. Pp. 160-163.
47. Maritime Water Supplies. By A. A. Laflin. Pp. 164-165.

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2. Meeting the Demand for Recreation Facilities Near Public Water Supplies. By D. E. Moulton. Pp. 370-375.
3. The Corrosion Problem in Cambridge, Mass. By M. C. Whipple. Pp. 376-379.
4. Influence of Dissolved Oxygen in Accelerating the Corrosive Action of Water. By F. W. Gilcreas. Pp. 380-383.
5. *t.* Neutralization of Corrosive Action. By R. S. Weston. Pp. 384-389.
6. Development and Use of Spun Bituminous Coating for Water Pipe: In Great Britain. By J. Mitchell. Pp. 390-392. In the United States. By G. E. Boyd. Pp. 393-401.
7. Qualifications of Operators of Water Treatment Plants. By W. J. Scott. Pp. 402-408.
8. The Needham Gravel-Packed Well. By B. F. Snow. Pp. 409-423.
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10. Additional Ground Water Supply for Woburn, Mass. By J. P. Wentworth. Pp. 430-436.
11. Some Operating Experiences with Iron and Iron Coagulants in Water Treatment. By M. Pirnie. Pp. 437-453.

D *The Surveyor*
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9. Water Supply in 1937: Annual review. Pp. 117-124.

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8. New Data on Pipe Joint Strength. By L. Small. Pp. 180-182.

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V *Journal, Maine Water Works Utilities Assn.*
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1. Anchoring 16-Inch Main on Subaqueous Ledge. By W. Robbins. Pp. 11-15.

Methods in Highway Maintenance and Betterments

By JAMES E. LAWRENCE

Maintenance Engineer, Massachusetts Department of Public Works

THIS is part of a paper Mr. Lawrence presented at the recent meeting, at Atlantic City, N. J., of the Association of Highway Officials of the North Atlantic States. Those portions describing surface and subgrade maintenance and betterment work have been omitted from this article. The paper begins with the statement:

While highway maintenance has been defined as "the art of keping the roadway, structures, and the remaining area within the right of way in as good condition as it was when originally constructed," experience has proved that most of the highways which were constructed a few years ago are in better condition today than they were at the completion of construction, as the result of betterments, such as widenings, additional drainage, surface treatments, etc.

Shoulders, Gutters and Slopes

The maintenance of unhardened shoulders constitutes a major item of expense and requires almost constant attention on heavily traveled routes, as it is necessary that they be brought up to grade by adding new gravel about once a year, treated with road oil to lay the dust, and dragged sometimes as often as once a week. Soft shoulders constitute a potential accident hazard. Any program of maintenance betterments should include the work of hardening and widening shoulders, with preference being given to sections on steep grades where erosion is likely to occur, on curves, in residential sections, and on heavily traveled roads. Sections where car tracks have been abandoned and removed should also be widened and hardened. Gutters and shallow ditches may be eliminated in cut sections where the shoulders have been hardened to the bottom of the slope. The shoulder may be hardened, with the surface and sub-base of the same design as the pavement section, but in the case of cement concrete roads, it is often more convenient to make the widening of bituminous macadam or bituminous concrete as this material is better suited for this type of work. A base course consisting of 4″ of broken stone and a 2″ surface of bituminous concrete makes a very satisfactory shoulder.

A serious problem that should be given due consideration is that of providing places where cars may park off the traveled way. Truck drivers who are traveling long distances often find it necessary to pull off the road and get a little sleep. Travelers need a place where they may stop and rest, make minor repairs and put on or take off skid chains in winter. Picnic parties desire a place where they may stop and eat lunch and enjoy the scenery while they are eating. It is dangerous for any car to park on the pavement, yet most motorists will not drive off the hardened surface, even if there is room, for fear of getting on soft ground. Many serious accidents have happened where cars, especially trucks, have stopped on the pavement in some isolated section, and other cars have come along and run into them.

Parking areas with hardened surfaces should be provided at regular intervals to relieve this condition. The sites for these areas should be selected with care in order to make them attractive to motorists and invite them to make a practice of stopping at these places. Locations adjacent to wooded areas, rivers, brooks and lakes are very desirable. These areas may be developed at small cost, and are worthwhile betterment projects.

Deep ditches parallel with the roadway should be eliminated by the construction of underground drainage systems, and slopes in fill sections flattened wherever this is practical. Soil erosion in cut sections can be materially reduced by flattening the slopes, seeding, sodding and planting trees, and by cutting ditches a few feet back from the top of the slope in order to intercept surface water which would otherwise flow down the slope.

In some instances where slides occurred in deep cut sections during heavy rain storms, the slopes were flattened, sodded and terraced, and underdrains were installed to intercept the ground water which is the contributing cause to a slide. Thus the surface water was slowed up to such an extent that surface erosion was prevented, and the underground water confined to a safe channel.

Guard Rails

An effective guard rail should retard and eventually stop a vehicle which is out of control without serious injury to the vehicles or its occupants, but in so doing should not cause the vehicle to rebound onto the roadway into the path of oncoming traffic.

Wooden guard rail has little effect in stopping a vehicle which is moving at a fast rate of speed, and there is some danger of the occupants of the vehicle being injured by broken parts of the rails. This would indicate that construction of wooden guard rail should be limited to sections which are protected by curbing and where vehicles are moving at a slow rate of speed.

The replacement of wooden guard rail in open country and especially at dangerous locations with newer types, such as cables, tapes, and steel plates which have strength, resilience and a tendency to deflect vehicles should be considered of vital importance in reducing injuries to motorists and should be included in the betterment program of maintenance work.

Sidewalk Construction

Sidewalks for many years have been included in the construction of city and town streets in thickly settled urban areas, but until recent years they were not considered in the construction of highways in suburban areas. Thousands of pedestrians have been killed by automobiles while walking on these highways, and a public sentiment has been aroused and is demanding that something be done about it. Automobile drivers are as anxious as the pedestrians to have sidewalks constructed, as almost every autoist has experienced the agony that comes to him when he suddenly comes upon

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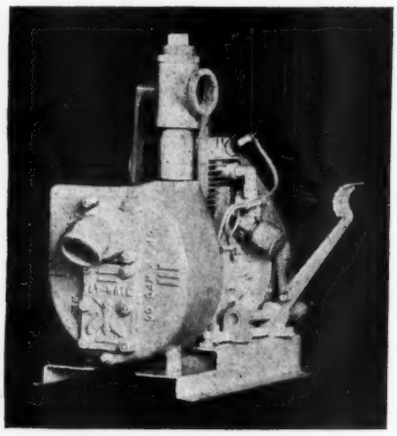

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a traveler on a rural highway during the night, and is only able to stop or avoid an accident by the merest fraction of an inch.

In 1935 the Legislature in Massachusetts authorized the Department of Public Works to construct sidewalks along state highways and also a bond issue to cover the cost of construction. To date approximately 500 miles of sidewalks have been constructed. The locations where these sidewalks were constructed were determined by examining records which showed where pedestrian accidents most frequently occurred.

The better type of construction was used in residential areas, which included a good grade of granite curbing and a bituminous concrete surface. Less expensive curbing was used in rural areas, and the width of the sidewalk reduced. In some places where it was impractical to install curbing and make expensive cuts and fills, incurring land damage, the sidewalks were constructed to conform to the natural contours of the abutting property.

Sidewalk construction is a betterment which protects pedestrians, a large part of which are school children, relieves the mind of the autoist and increases the value of the abutting property owner's land. Surely everyone must come under one of these classifications and will therefore be pleased to see money spent for this purpose.

Roadside Maintenance and Improvement

Modern superhighways have necessitated a change in methods and equipment used in maintaining roadsides. Wide strips of grass between divided roadways, and narrow strips between sidewalks and curbings must be mowed regularly if the beauty of the roadside is to be maintained. Slopes in both cut and fill sections which were formerly left with dirt, sand or gravel surfaces are now loamed, and seeded or sodded and these also must be mowed.

In years past it was necessary to mow the roadsides only once or twice a year and the horse-drawn sickle bar mower seemed to do a satisfactory job if the hand scythe was used to finish up the places which could not be reached with this type of mower. Today, motor mowers have in many cases replaced the horse-drawn equipment, as they are capable of mowing slopes and irregular areas which could not be mowed by horse-drawn equipment.

Planting of trees and shrubs for beautification and the prevention of erosion has an important place in maintenance and betterment work. Natural growth trees and shrubs are carefully preserved and other undesirable growth is removed in order to unfold their beauty.

Winter Maintenance

The increase in transportation of goods by truck and the increase in passenger vehicle traffic within the last few years has required rapid changes in volume and methods of winter maintenance. The speed with which this work can be accomplished is of most importance, and the personnel and equipment used on snow removal and ice control must be organized in such a manner that this work may be started within an hour after unfavorable conditions develop.

The four-wheel-drive snow removal unit has replaced the slow moving units where speed is required. These modern units have sufficient traction and are capable of attaining speed of 35 to 40 miles an hour. They are equipped with interchangeable plows—"V" and "one-way"—which enables them to be used as patrol units or emergency units. They are also equipped with special electrical systems, air brakes, mechanical sand-

spreaders, hydraulic steering and special hydraulic systems to operate the plow and wing.

Each fall, the operators of snow removal equipment are required to attend a school where they are instructed how to properly operate and care for these units.

This equipment is stored in garages adjacent to the highways on which it is used, and provision is being made to provide storage space for this equipment in the abutments of new bridges which are being constructed in conjunction with the elimination of grade crossings, etc.

The abrasives used in ice control consist of clean, coarse, sharp, screened sand or washed stone screenings with a maximum size of ½". Washed sand is used whenever it is readily obtainable, and this material is obtained direct from commercial plants as it is required for use on the roads, as this method has proved more efficient and economical than stockpiling along the highways

These abrasives are chemically treated with calcium chloride or sodium chloride with a maximum of 100 pounds of chemical per cubic yard of sand for use on bituminous surfaces, and 50 pounds of chemical per cubic yard of sand on cement concrete surfaces.

Sand-Bituminous Stabilization

In order to obtain a low cost, year-round pavement in sparsely populated sections of the State where existing road material was impassable sand or silty sand, the Florida State Road Department began the work of stabilizing these with bituminous material.

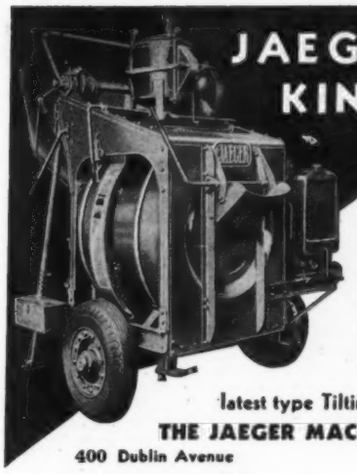
Stabilization of sandy soil has been accomplished in Forida by the addition of bituminous material, in proper quantity, to existing road material. This is mixed uniformly in place with harrows and graders or a traveling plant mixer, and then compacted with rollers.

Stability tests on the sand were made prior to addition of bituminous material, and if necessary the stability was increased by the addition of other fine aggregate, pulverized lime-stone or similar material having greater stability. Bituminous material used in this work has been cut-back asphalt and tar.

The results obtained have been entirely satisfactory. About 325 miles of this type of road constructed to date are carrying traffic with a very low maintenance cost. When the surfaces began to show signs of wear they were converted into bases by applying surface treatment. In some cases the surface treatments have been necessary in about two years, while other pavements have gone seven years and are still holding up. The necessity for treatment depends on the type of bituminous material used and the amount of traffic.—By H. C. Weathers, before Highway Research Board.

Dispersion of Volume of Traffic by Hours, Days and Months

It has been assumed by many that if sample records of highway traffic be confined to certain hours of the day, days of the week, and months of the year, the dispersion will be less than if the observations are taken at random through the year. For Holland Tunnel and George Washington Bridge calculations show that from 8 to 12 in the morning and from 3 to 7 in the afternoon are the best hours of the day. For the months, July, June, August and March are the most nearly constant in hourly variations, while April and May and September through November are more highly variable. Of the days of the week Wednesday and Saturday are best and Monday and Tuesday most variable.—By W. A. Shelton before Highway Research Board.



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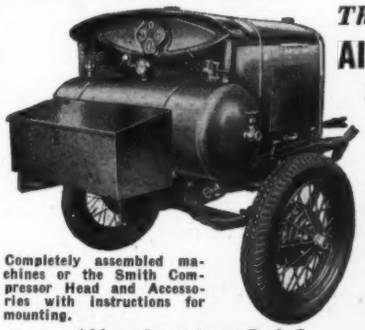

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A Digest of the Sewerage Literature of the Month giving the main features of all the important articles published

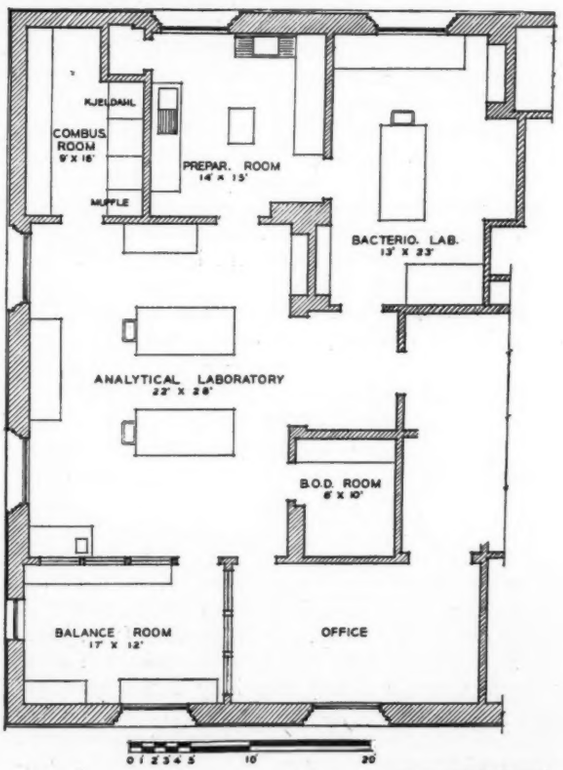
The Digestion Tank

Packinghouse wastes at Sioux Falls, S. D., have a population equivalent of 103,000 while the actual population contributing sewage is about 31,500. All is treated in a plant combining chemical treatment, trickling filters and activated sludge. Packinghouse sludge passes through a flocculator before entering the primary clarifier. Sludge is digested, but excess is run into a lagoon. Chemicals are seldom used, tests showing that adding 25 ppm of ferric chloride gave practically no improvement, and 45 ppm increased BOD removal to 49% against 40.4% with flocculation alone. Septic sludge frequently received from the packinghouse pretreatment plant is definitely detrimental to the activated sludge plant. The over-all removals by the entire plant average 98.6% suspended solids and 98.9% BOD, with an average of 10 ppm of each in the effluent; and a reduction in total 37° bacteria of 99.97%.[C6]

Activated sludge plant operation should be based, not on "smell, look and feel," but on definite knowledge of the oxygen demand of the sludge and its activity. "Sludge demand" is the amount of oxygen, in ppm per hour, that is used by a 0.50% solids sludge, which has had its normal period of aeration since being mixed with sewage. "Sludge activity" is the rate of oxygen consumption, less the sludge demand, when synthetic sewage and sludge are combined to form a 0.50% mixture, expressed in ppm per hour. These tests for 2 years have been run at least every other day for each activated sludge tank at Indianapolis, and the results used to control them. The sludge demand varied from 10 to 85 ppm. To keep a plant in good condition it is necessary to keep the demand between 25 and 50 ppm. For best operating results the maximum activity should range between 70 and 100 ppm; if higher, the sludge will not concentrate well. Demand and activity can be controlled by changing either quantity of sewage flow or quantity of air used or quantity of mixed liquor solids. Excessive amounts of air will cause the sludge to burn up with a resulting loss of activity, so that when the next heavy load of sewage comes there is no biological life there to take care of it.[C17]

Sewage laboratories of 7 large plants completed in the past two years are described by E. Hurwitz. Flows to these plants vary from 50 mgd at Columbus to 400 at Chicago's south-west plant. The effective spaces occupied vary from 1110 sq. ft. at the former to 2530 at the latter—22 sq. ft. per mgd to 6.2, but all but the largest and smallest average about 13 sq. ft. Each has a general laboratory, 6 have bacterial laboratories, 3 a BOD room, 2 a hood room, 3 a balance room, 4 a research laboratory, 4 a wash or preparation room, 5 a store room, 3 a vault or record room, and Chicago has a coal oil materials testing room and Ward's Island a dark room. In general, the relative sizes of the chemical and bacteriological rooms vary with the volume of each type of work contemplated. Steel with baked enamel finish is in common use for laboratory furniture. Soapstone table tops are used by 4 plants. Chicago and Buffalo use birch with a carbonized black acid-proof finish covered with hot paraffin. Chemical stoneware sinks are used by 6 plants, the 7th of soapstone. Floor coverings are of asphalt tile, cork tile, rubber tile, and battleship linoleum. Electrical equipment is used by most, but Buffalo uses sludge gas where close thermostatic control is not necessary. All use Duriron equipment for Kjeldahl digestion units. Both gas and electric water stills are used.[C21]

Sludge digestion with the use of lime and that of activated carbon were compared on a laboratory scale in the Baltimore plant. The experiments indicated that lime is more effective than activated carbon in increasing speed of digestion. With unseeded raw sludge, activated carbon and lime did not give as good results as lime alone, but the two methods gave about the same results when seeded raw sludge was digested. When seeded raw sludge was digested with and without the addition of activated carbon alone, four laboratory tests showed the untreated sludge digesting more rapidly than material treated with activated carbon, while in two the activated carbon gave better results during the latter portion of the digestion period; but previous tests at Baltimore in 1936 had indicated that activated carbon hastened digestion. "These conclusions apply to Baltimore conditions."[C18]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ANALYTICAL LABORATORY 22' X 28'
B.O.D. ROOM 6' X 10'
BALANCE ROOM 17' X 12'
OFFICE
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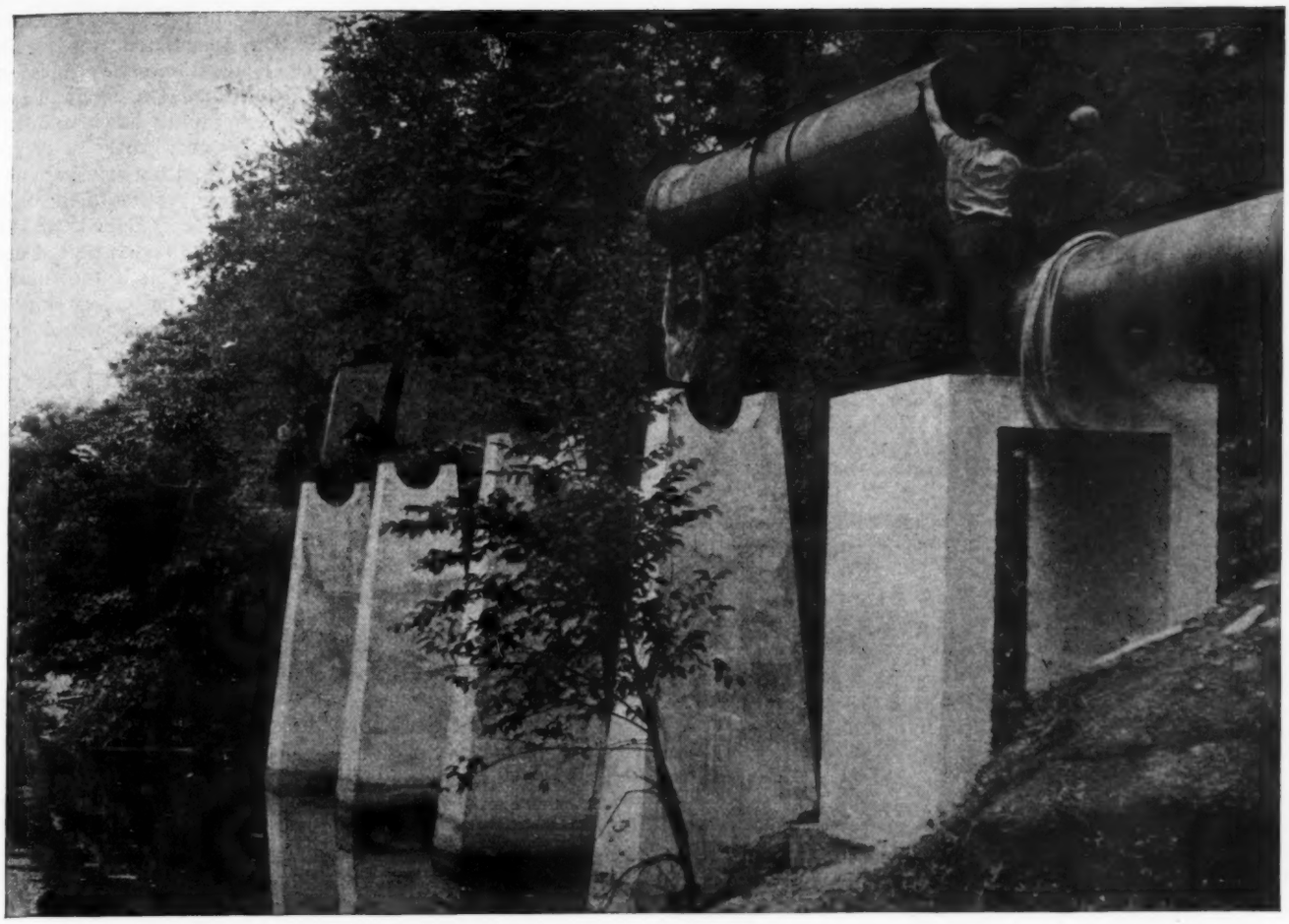
Sewage Works Journal

Sewage laboratory at Cleveland, O. East plant.



Installing U. S. Super-de Lavaud Cast Iron Pipe for pressure sewer at Highland Park, N. J.

The trend to cast iron pipe for pressure sewers is evidence of the growing demand for permanent construction. Cast iron pipe is an impermeable material immune to acid trade waste. It effectively resists corrosion. It has great compressive and beam-load strength. Its joints are permanently tight and therefore infiltration-proof. We furnish cast iron pipe in a wide range of sizes and fittings. U. S. pit cast pipe is made in diameters up to 84 inches—Super-de Lavaud *chill-free* centrifugally cast pipe, 24 inches and under. Quick service from 15 shipping points.

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Activated sludge contains organisms, several cultures of which, when isolated and inoculated into sterile sewage, gave considerable clarification under quiescent conditions and also with aeration. The oxygen consumed values did not decrease so rapidly as the tubidity. When sterile sewage containing only finely dispersed and soluble material is inoculated with a small amount of activated sludge, a considerable portion of the original organic carbon is found in the sludge. With certain pure cultures, the amount of finely dispersed and soluble organic carbon transferred into the sludge phase is smaller than with activated sludge inoculation; these organisms destroy the sludge formed, with longer periods of incubation.[C19]

There are two general views as to the mechanism by which ammonia is removed from sewage liquor—by physical means, such as adsorption or base exchange; or by biological agencies. Experiments indicated that base exchange is not a likely mechanism in the uptake of ammonia by activated sludge, but that biological assimilation is, the use of chloroform showing that no removal of ammonia takes place in the absence of biological activity.[C20]

Sewer rentals finance sewerage improvements in Iowa City, Ia. Charges are based on monthly water consumption and the 5-day B O D of the sewage, the rates per 100 cu. ft. being: for B O D of 0-100 ppm, 3 cts.; for B O D of 100-400 ppm, 7.5 cts.; for over 400 ppm, 15.5 cts. Domestic sewage is assumed to be in the second class. Water used for air conditioning is metered separately and billed at the lowest rate. Much cooling water, formerly discharged into the sewers, has been diverted to storm drains, and since the rates went into effect the sewage flow per capita has fallen about 20% and the B O D has increased from 233 to 370.[C26]

Plant efficiency of the Iowa City, Ia., treatment plant is unusually uniform throughout the year. Monthly averages of B O D removal varied less than 4% from the yearly average, which was 47.3% for the primary clarifiers and 83.2% for the filters and humus tank, or 91.1% for the entire plant. The temperature ranges from —20° to +90°. This is attributed to "the improvements in clarifier design and to the reduced air exposure of sewage as it is applied to the filter surface," on which rotary distributors are used.[C26]

Dairy wastes are the most common producers of nuisance among industrial wastes. The most common satisfactory methods of disposal are dilution, broad irrigation, chemical precipitation and biological filtration. For dilution, this should be at least 50 to 1 for normal milk wastes. Irrigation on isolated land is satisfactory when properly maintained. Chemical precipitation has been effected with copperas and lime; impracticable except for the more concentrated wastes with secondary treatment. Two recent installations are adaptation of the Guggenheim process—hydrated lime and ferric sulphate to raw wastes, aeration of mixture for 4 hrs., settling and return of sludge to waste entering aeration channels; gives high degree of treatment—Trickling filters produce a satisfactory effluent if liquid applied does not contain over one pound of milk solids per 80 cu. ft. of filter volumes per day with filters of 6 to 10 ft. depth; continuous or frequent dosing is best. In most plants reduction can be made in the milk solids losses, often by recovery of by-products. Chlorination is effective in preventing acid fermentation and odors where irrigation or dilution is employed.[C27]

Bibliography of Recent Sewerage Literature

The articles in each magazine are numbered continuously throughout the year, beginning with our January issue.

c, Indicates construction article; *n*, note or short article; *p*, paper before a society (complete or abstract); *t*, technical article.

C *Sewage Works Journal*

January

16. *t.* The Viscosity or Pseudo-Plastic Properties of Sewage Sludges. By W. D. Hatfield. Pp. 3-25.
17. *t.* Studies of Activated Sludge Oxidation at Indianapolis. By D. E. Bloodgood. Pp. 26-32.
18. *t.* Comparative Effects of Activated Carbon and Lime on Sludge Digestion. By C. E. Keefer and H. Kratz, Jr. Pp. 33-42.
19. *t.* Studies on the Clarification Stage of the Activated Sludge Process. By H. Heukelekian and H. B. Schulhoff. Pp. 43-48.
20. *t.* Studies on the Clarification Stage of the Activated Sludge Process. By R. S. Ingols. Pp. 49-59.
21. Recent Laboratories for Large Sewage Treatment Works. By E. Hurwitz. Pp. 60-73.
22. Aspects of Sewage Chlorination in 1937. By L. H. Enslow and H. A. Faber. Pp. 74-80.
23. The Disposal of Sewage and Garbage—Related Municipal Functions. By M. M. Cohn. Pp. 81-90.
24. Chemical Treatment of Sewage. By P. B. Streander. Pp. 91-99.
25. Developments in Sewage Sludge Incineration. By M. B. Owen. Pp. 100-105.
26. Sewage Treatment at Iowa City, Ia. By E. L. Waterman and R. E. Rostenbach. Pp. 106-114.
27. Practical Methods of Preventing Dairy Waste Nuisance. By C. C. Agar. Pp. 115-131.
28. Gadget Contests: New York and Central States. Pp. 132-137.
29. Operation of Imhoff Tanks. By C. Samson. Pp. 143-146.
30. Separate Sludge Digestion without Heat. By L. R. Smith. Pp. 146-149.
31. Separate Sludge Digestion in Heated Tanks. By H. O. Johnson. Pp. 149-153.
32. Operation of Open Sludge Beds. By W. A. Ryan. Pp. 153-158.
33. Operation of Covered Sludge Beds. By E. A. Marshall. Pp. 158-160.

D *The Surveyor*

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14. *p.* The System Activated Sludge/Oxygenated Water. By D. Dickinson. Pp. 86A-86B.
15. *p.* Application of Fluorescent Indicators to the Acidimitry of Trade Effluents. By D. Dickinson. P. 86B.

January 28

16. Sewerage and Drainage in 1937: Annual review. Pp. 124-133.
17. Sewage Purification at Stockport. Pp. 151-152.
18. *p.* Treatment and Disposal of Trade Waste Waters. By A. Parker. Pp. 187-190.

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19. *p.* Filter Pressing of Sludge. By J. T. Thompson and J. W. Procter. Pp. 235-236.

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20. The Relay System of Refuse Collection. Pp. 236-264.
21. New Refuse Disposal and Salvage Plant, Burnley. By J. L. Beckett. Pp. 265-266.
22. Sewage Disposal in South Africa. By H. Wilson. Pp. 275-276.
23. *p.* Filter Pressing of Sludge. Discussion of D19. Pp. 285-289.

E *Engineering News-Record*

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4. *c.* Relief Sewer Ends River Pollution (Boston Met. Dist.). By T. T. Berrigan. Pp. 140-142.

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5. Status of Sewage Treatment. Pp. 219-221.
6. Survey of Sewage Treatment. By G. B. Gascoigne. Pp. 238-239.

G *Water Works and Sewerage*

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12. Progress in Sewage Treatment During 1937. By E. T. Killam. Pp. 81-89.
13. Grease Separation Enhanced by Aero-Chlorination. By C. E. Keefer and E. C. Cromwell. Pp. 97-99.

H *Municipal Sanitation*

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27. Activated Carbon Reduces Odors and Scum at Medina, O. By H. E. Orford and E. J. Scharch. Pp. 124-126.
28. Trituration Solves Elgin's Screenings Problem. By E. E. Smith. Pp. 127-129.
29. Incineration of Municipal Refuse. By H. W. Taylor. Pp. 130-132.
30. Aeration De-greases Sewage. By F. C. Roe. Pp. 133-134.
31. A Small Sewage Plant Can Be Modern. By J. W. Shikles. Pp. 135-136.
32. Modern Primary Treatment Plant for Highland Falls, N. Y. By T. F. Bowe. Pp. 141-142.

J *American City*

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8. Tannery Waste Treatment in Pennsylvania. By F. B. Milligan. Pp. 50-52.
9. The Care of Screenings Shredders. By R. J. Bushee. Pp. 53-54.
10. *p.* Utilization of Sewage Sludge as Fertilizer. Pp. 54-55.
11. Incinerators for Garbage and Refuse Disposal. By H. S. Hersey. Pp. 61, 63, 65, 67, 69.

M *Canadian Engineer*

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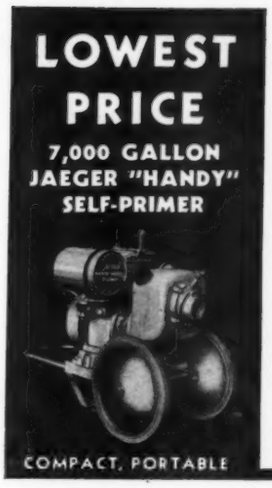
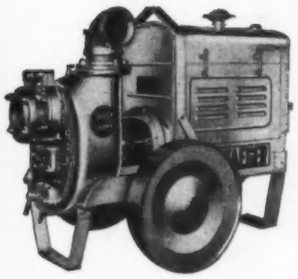
2. Sewage Treatment Plant for Greater Winnipeg. By W. P. Brereton. Pp. 5-9.

T *Technique Sanitaire*

December

1. La Technique Sanitaire au Service de l'Exploitation Agricole. By M. Vignerot. Pp. 325-330.





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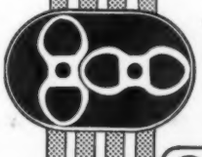

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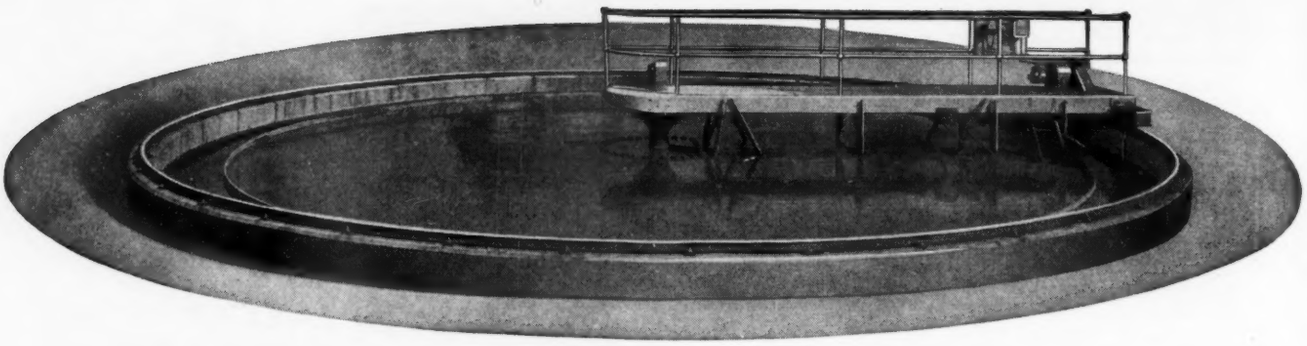

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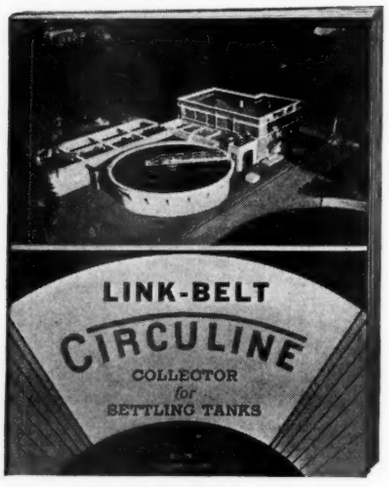

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Legal Decisions Regarding Municipal Problems

Nonresident's use of Town's Sewage Disposal System

Under the Colorado Constitution, a town may make a valid contract with a nonresident permitting him to use the excess capacity of the town sewage disposal system by connecting with the town's sewer, provided the contract is limited to a period during which the town does not require the entire capacity of its sewer system. All the town can grant is a revocable permit; not a perpetual privilege. Where the nonresident has contributed money for the town's sewage disposal plant, the Colorado Supreme Court held (Town of Estes Park v. Mills, 65 P. (2d) 1086), that the town was not entitled to collect a subsequent maintenance assessment from the nonresident's administratrix or in the alternative disconnect the sewer, merely because its operation had become more expensive, in the absence of proof that the town required the entire sewage capacity of its system.

Cost of Repairs Under Maintenance Bond

In an action on a statutory maintenance bond brought by a municipality against a contractor and the surety on the bond for the cost of repairs to paving, the Oklahoma Supreme Court held (Strong v. Incorporated Town of Beaver, 73 P. (2d) 405) that it is a condition precedent to such an action that the municipality first make such repairs, or cause them to be made, and that the cost thereof be certified to the city treasurer, approved by the city council, and the contractor and bondsmen be notified of the amount thereof. The court said that it might be that the cost of the repairs would not have equaled the amount of the bond by a wide margin, and that the defendants were entitled to have the extent of their liability determined by the practical test thereof which is prescribed by the Oklahoma statute. Judgment for the plaintiff was reversed and the cause remanded. The decision was by a court divided 5 to 4.

State Not Liable for Fire Protection in Cities

An appeal to the New York Appellate Division from an order of the State Court of Claims dismissing a claim against the State of New York for the loss of property destroyed by a fire of unknown origin in a warehouse in a city presented a novel question of law. The claimant urged that the duty of furnishing adequate fire protection to its citizens is a State function. The court said (Hughes vs. State, 299 N. Y. S. 387), that "no authority is cited to support such a startling proposition nor has our own investigation disclosed any. * * * In our opinion there is no moral or legal obligation resting on the State to furnish such protection. In order to impose a liability on the State there must be an obligation on its part. The State may not assume liability where there is none. If the State is obligated to protect the inhabitants of its municipalities against loss by fire then by the same token it must give like protection to all its residents, including those living in isolated sections within its boundaries." The order appealed from was affirmed.

Right to Charge Tenants for Water

The charter of the city of Santa Rosa, Calif., makes it mandatory on the Board of Public Utilities to provide regulations for furnishing water free in reasonable quantities for domestic use. The California Supreme Court, in Page v. City of Santa Rosa, 65 P. (2d) 775, held that it would be within the power of the board, upon fixing a definite quantity as a reasonable amount for domestic uses, to make a charge for the use of any water used in excess of the quantity found to be reasonable. Water may be wastefully used in serving domestic uses, and for that and other reasons its use is subject to regulation. In the absence of contrary proof it would be presumed the board's official duty had been regularly performed.

The owner of leased premises could not compel the city to furnish water to his tenants who were in default in their compliance with the city's rules and regulations. Under such a charter provision the rule is that the water is supplied to the inhabitants and not to the owners of the premises. The tenant users of water are responsible for charges for the excessive use of water by them, and not the owner of the premises merely because of his ownership.

Statutory Mode of Contracting with City for Engineering Services Must Be Observed

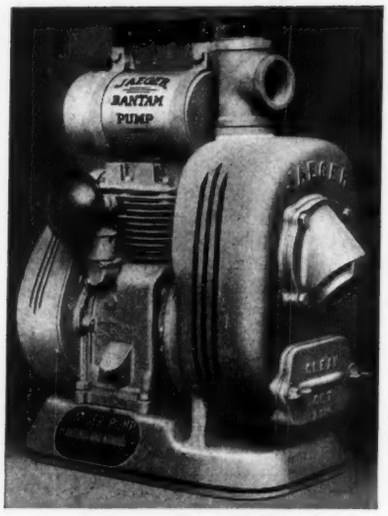
An engineer specializing in sewage projects sued a city to recover the reasonable value of services rendered by him to the city in preparing plans and specifications for a sewage disposal plant. He alleged that the services were accepted by the city and were reasonably worth $2,163, only $50 of which had been paid.

The Oregon Supreme Court (Forrester v. City of Hillsboro, 66 P. (2d) 496), sustained a demurrer to the complaint because plaintiff had not alleged compliance with the city's charter providing the mode in which such contracts must be executed. The charter provides that the city shall not be bound by any contract not authorized by ordinance or resolution and made in writing, signed by the mayor and attested by the recorder of the city, when in excess of $100.

The court said that the city had power under its charter to construct a sewage disposal plant; so the contract was not ultra vires. But a contract with a municipal corporation must have been entered into in the mode provided by statute or the charter. Acceptance of services by the city could not be relied upon as a basis of liability. The plaintiff was held bound to know the extent of authority of the city's manager who employed him, and also the mode in which such contracts must be executed. When he proceeded without compliance with the mandate of the charter, he assumed the risk of nonliability. As applied to the individual, it may be a harsh rule, but is considered necessary, by the weight of authority, for the protection of the public against improvident contracts.

These views of a road surface treated with cut-back asphalt were sent us by Trimble B. Reynolds, engineer of the Benzie Co. Road Commission, Honor, Mich. Both are along Crystal Lake, which is shown at the left.

Keeping Up With New Equipment



New lightweight centrifugal pump.

52 Pounds—5200 G.P.H.

This automatic priming pump, built of aluminum alloy and weighing only 52 lbs., is produced by The Jaeger Machine Company, Columbus, Ohio. Its rated capacity of 5200 gallons per hour is said to be the largest ever developed by a pump of this light weight. The priming action uses the Jaeger patented priming jet, and is said to be effective at lifts up to 25 ft. Including standard ¾-1-hp. ball bearing engine with carburetor and unusually large gasoline tank of .4 gallon capacity, the Bantam measures only 9½ x 19 inches, may easily be carried by a boy or shoved into the front or back of any automobile. It is also furnished with ½ hp. splash-proof electric motor which may be plugged into any light socket.

Built for draining small footers and ditches, pumping seepage, filling tank wagons, etc.; also to serve as a completely portable pump for public utility and municipal maintenance departments, fire departments, for pumping out basements, factories, plumbers, barge lines, small boat owners, and suburban and summer homes and camps.

Proportioneers' New Nozzle

A new injection nozzle has been developed by Proportioneers, Inc., Providence, R. I., for connecting hypochlorinators into pipe lines. This is of special metal, not affected by hypochlorite, is leak-proof, practically unbreakable, has large openings and is easy to install. Good for maximum pressures up to 250 pounds. All this on the authority of Jeff Corydon.

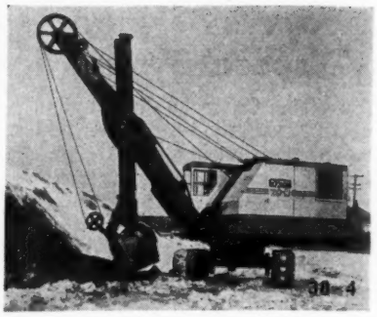
"When the Wind Blows . . ."

Flick on the switch, count the audible signals or the light flashes for one minute and you have the correct wind velocity. No references to correction tables is required, for this anemometer is correct within 1 mile per hour at all ranges. The transmitter is 8 inches high and weighs one pound. Needs attention about once a year. Almost a necessity for airports and similar places; fine for the home. For further information on this cheap and excellent equipment, write Julien P. Friez & Sons, Inc., Baltimore, Md. They have a small folder that's interesting.

Friez Anemometer.

The "Speedlined" Excavator

We don't exactly know what a "speedlined" machine is, but a power shovel, convertible to dragline, clamshell, crane, or dragshovel, is announced as such by the Bucyrus-Erie Company, South Milwaukee, Wis. This is known as the 29-B, is a 1-yard excavator, modern and up-to-date. It is equipped with a speed-type cast V-front, welded dipper, with "Beco Tiger Teeth," quickly reversed, resharpened, or replaced.



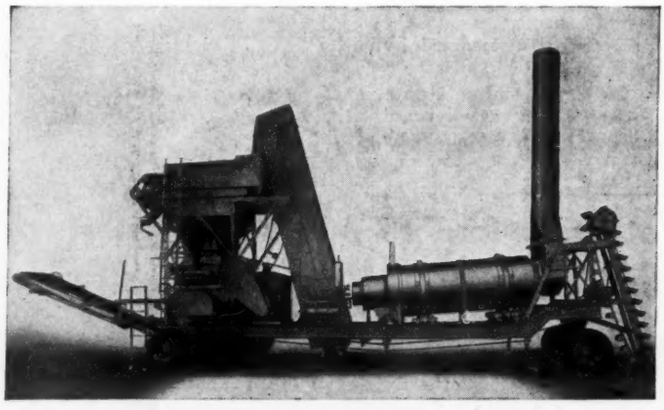
Bucyrus-Erie 1-yard excavator, 29-B.

Bulletin FBE 29B1 fully describing and illustrating these and many additional important features together with completely detailed specifications may be obtained upon request to the Bucyrus-Erie Company, South Milwaukee, Wisconsin.

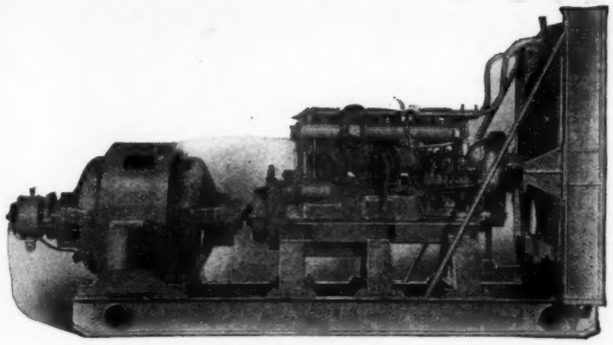
A Portable Hot-Mix Asphalt Plant

This is a hot-mix plant that will trail along at 20 to 30 miles an hour, according to the makers; made in full or semi-trailer types. Includes cold elevator, drier, hot elevator, vibrating screen, storage bin; asphalt buckets, asphalt and aggregate weighing scales, aggregate hopper, asphalt pump and 1000-pound pugmill. All of these units are mounted on one chassis which is carried on pneumatic tires. Necessary accessory equipment not furnished includes steam boiler, asphalt and fuel oil storage tanks and the required yard piping.

A good folder has been issued describing this "Speedline" plant. It will be sent on request to A. C. Gossard, Iowa Mfg. Co., Cedar Rapids, Iowa.



Cedar Rapids portable hot mix plant.



The Sterling Engine Co., 150 KW, 1800 rpm. emergency set, shown at left, was developed for the Philadelphia Electric Co. for inspection of instruments and tests. The weight, which was limited, is 11,160 pounds. The engine is 6-cyl., 240 h.p. Governor regulation is within 3% on full load or part load changes. This is perhaps the most compact, high-powered generator unit in the country.

Removing Paint, Scale and Rust From Steel

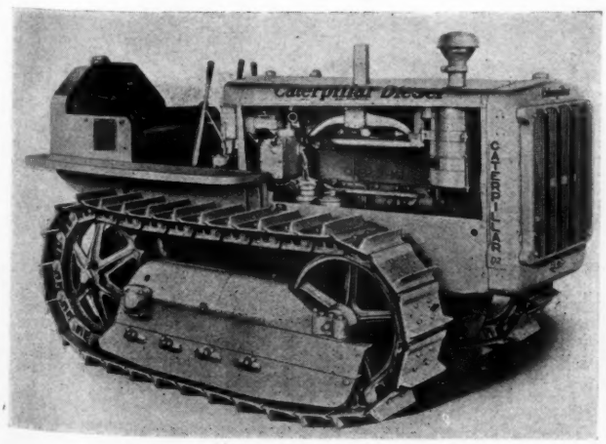
This is a portable hand tool for cleaning concrete, steel, brick or other hard surfaces. It gives a mechanical sand-blast effect without the sand. Light—it weighs from 7 to 21 pounds, depending on the size—and adaptable to a variety of work. Operates by electric current or by compressed air. You can use it to clean or smooth your concrete, prepare your water tank for painting, and for a lot of other uses. Concise, but good, folder from Aurand Mfg. & Equipment Co., Box 83 SY, Cincinnati, Ohio.

Aurand portable cleaner.

A New Small Diesel Tractor

Caterpillar has announced a small diesel tractor—the D2—which has 25.5 drawbar horsepower which will handle appropriate blade graders, smaller maintenance machines, terracers, rollover scrapers, etc. The makers say that it uses, on such work, 1¼ gals. per hour of low-cost fuel. A unique feature is a twin radiator, one for cooling the water and the other for cooling the lubricating oil. There is a bulletin out on this which will be sent on request to Caterpillar Tractor Co., Peoria, Ill.

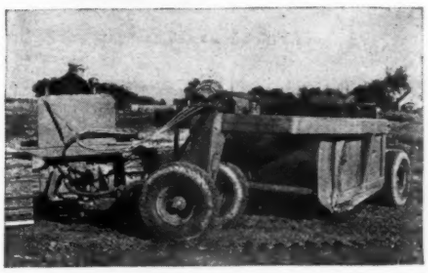
Below: Caterpillar 25.5 hp. Diesel.



The No-Guess Hydraulic Scraper

The Heil Co., Milwaukee, Wis., has a new hydraulic scraper. The "No-Guess" feature is an indicator dial mounted at the front of the scraper, which indicator shows the operator the depth of the cut, or the height of the bowl above the ground, when spreading. This takes all the guesswork out of scraper operation.

Only three hydraulic cylinders, which are exactly alike, with all components parts interchangeable, are required to operate the scraper. A specially designed roatary gear pump provides the necessary hydraulic power.

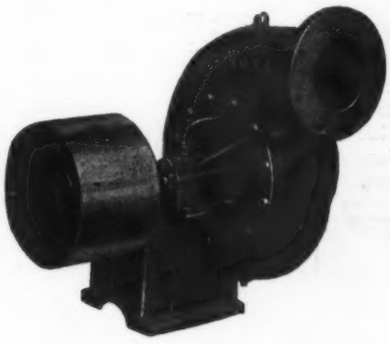


Heil hydraulic scraper.

18 Sizes of New Goulds Pumps

Goulds Pumps, Inc., Seneca Falls, N. Y., announces a complete line of single stage, side suction, ball bearing centrifugal pumps. There are eighteen sizes with capacities from 5 to 1800 g.p.m. against heads up to 110 ft. for flat or V-belt or direct motor drive. These pumps are designed for general water supply; circulating service; contracting and building work; irrigation; and similar jobs.

New Goulds Bulletin No. 210 gives complete details, some very interesting data tables and all needed information. Sent on request.



One of the Goulds pumps.

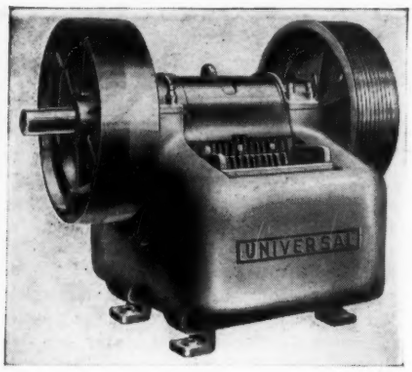
Below: Part of the 300 refuse body units for New York City Department of Sanitation ready to start from the Gar Wood factory. G. M. C. truck chassis; Wood body and hoist; Palmer-Bee mechanical refuse loader.

KEEPING UP WITH NEW EQUIPMENT

The Hough One-Way Tractor Sweeper is designed for municipal, park and industrial work, sidewalk and street sweeping. Brush is set at 30° angle. Shown without brush dust hood and chain guards. Broom is 72" long when mounted on I-12 International Tractor and 84" long for the I-30. Frank G. Hough Co., Chicago, Ill.

To Make More Little Ones Out of Big Ones

With modern bituminous highway construction, more little stone is needed, and most of the crushers in use have either a limited stage of reduction, or a lower operating rate (a lot lower) if small stone is to be produced. The Uni-

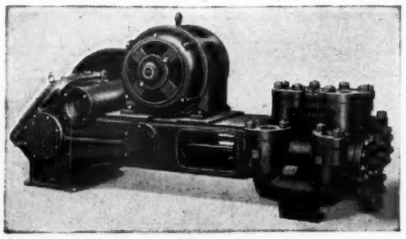


The new Universal crusher with high-ratio reduction.

versal Crusher Co., Cedar Rapids, Ia., have brought out a new jaw crusher for which a number of advantages are claimed, among them that "there is no other crusher that will give as high a ration of reduction . . ." This company has issued Bulletin 4-A, which is really a 2-page sheet of data, describing this new unit. The bulletin will be sent on request.

Fairbanks-Morse Duplex Power Pumps

Fairbanks, Morse & Co. has announced new duplex power pumps for pumping water, oil or other free-flowing liquids



Above: Fairbanks, Morse pump.

in quantities up to 187 g.p.m. and at pressures up to 1000 lb per sq. in.

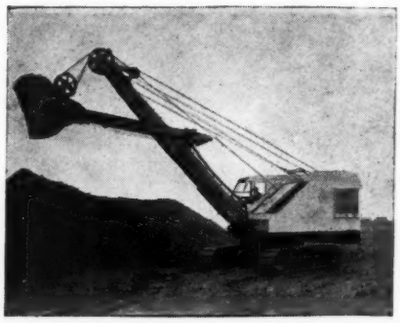
These duplex power pumps are fully described in Bulletin 6185, available upon request from Fairbanks, Morse & Co., 900 S. Wabash Ave., Chicago, Ill.

The Smithmobile Truck Mixer

This is the newest truckmixer that has come to our attention. Made in 1½, 2, 3 and 4 cu. yd. truckmixer size; and, of course, has more capacity as an agitator. The mixing drum is a duo-cone, which, the makers claim, insures a better mix. There is also a combination charging chute and sealing door, but no hatch to open or close. High discharge without hoist. A bulletin describes this a lot better than we can. It will be sent on request to T. L. Smith Co., Milwaukee, Wisc.

Smithmobile truck mixer.

A mechanical zone marker that is safer for the markerman, who is up off the road. Fast, economical and accurate. Thiokol Corp., Yardville, N. J.



This is the new P & H model 555, 1¼-yard excavator, claimed to be very fast. Ask for Bulletin X-21, which describes it in detail. Mr. Slackford, Harnischfeger Corp., Milwaukee, Wisc.

For Placing Concrete Pneumatically

Hercules Steel Products Co., Galion, O., has brought out the Hercules "Crete-Mobile." This is a truck-mounted, truck-operated mobile unit for placing concrete pneumatically. It is operated by the truck motor through a power takeoff. Recommended for building and repairing highways, bridges, culverts, sidewalks, curbs, gutters, etc. It can also be used as a mobile sand-blaster. It combines truck body, air compressor, water tank, mixing tank, hose and discharge nozzle into one self-contained unit. Especially fine for reducing overhead on small jobs. Folder and description are available.

Hercules Cretemobile for concreting.

"Old Man River Speaks"

TEN years ago daily newspapers and engineering magazines were filled with stories of the Mississippi flood and of the plans that were being made to prevent recurrence of another flood with its attendant burden of disaster and suffering. That flood covered the first months of 1927; in early 1937 came another flood, also causing heavy damage.

Following the 1927 flood, many plans were advanced for solving the problem of "old man river." These varied from cutting canals direct to the Gulf of Mexico through a thousand miles of land, high and low, to storage reservoirs, levees set back several miles from the river; and higher levees in present locations. Cutting canals was obviously impracticable; the use of storage reservoirs was determined to be costly and to lower flood crests but a small amount, at the best: because the land normally slopes away from the Mississippi, levees 5 to 25 miles back from the river are impracticable because of necessary height and also because much riverside land is lost.

Informed engineers generally agreed that the river must be confined to its channel; also that the practical height of levees is limited. This is due to the fact that local materials—usually of rather poor quality for dams—must be used, and that subsurface conditions do not permit levee heights much in excess of twenty-five feet.

An essential condition of the problem for flood control was the protection of Cairo, Ill., a city of some 15,000 population situated on the tongue of land between the Ohio and the Mississippi at the confluence of the two rivers. At high water, portions of the city are 25 feet below the surface of the river.

A first step was the determination of the "super flood." The 1927 flood found the Ohio contributing about 960,000 second-feet, which was roughly 60% of the previous greatest volume in that river. The Mississippi contributed nearly as much, this being the highest flow recorded in the Mississippi. The total flow at Columbus, Ky., below Cairo, was 1,800,000 second-feet. It will be noted that if the 1913 Ohio flood of 1,583,000 second-feet was added to the 1927 Mississippi flood of 928,000 second-feet, a flow much in excess of the 1927 flood would result.

However, in 1937, the greatest known flood poured down the Ohio, carrying past Metropolis, 20 miles above Cairo, slightly over 1,800,000 second-feet. Fortunately, the Mississippi remained low, bringing but 171,000 second-feet. The combined discharge was about 2,050,000 second-feet past the gauge at Tiptonville, 40 or 50 miles below Cairo.

The plans, as finally adopted following the 1927 flood, for the control of the river, included a "fuse-plug" levee opposite Cairo, the construction of a setback levee to create the Birds-Point-New Madrid floodway, and general raising of levees all down the river. This floodway proposal aroused bitter controversy, especially among residents of East Missouri. The 1937 flood was the first one to require use of the floodway. Following it, hydraulic data have been prepared and presented to support the claim that the floodway is inadequate to protect Cairo.

L. J. Berthe of Charleston, Mo., long a consulting engineer specializing on levee work for various flood control and levee districts, has prepared a 36-page book, "Old Man River Speaks," which discusses the Birds-Point-New Madrid floodway in an interesting and instructive manner, and also presents data on the hydraulic phases of the 1937 flood. The matter covers controversial points; it was prepared, according to Mr. Berthe, because: 1. Of the criticism directed at the Jadwin Flood Control Bill as enacted by Congress in 1928; 2. The flood of 1937 applied the acid test to nearly all points at issue; 3. It is fitting to review the lessons of the 1937 flood; 4. The Jadwin plan called for no review by outside engineers; 5. The lessons of the 1937 flood have not hitherto been made available.

Mr. Berthe has prepared his material in the form of questions by the "interlocutor"; answers by the "generals" (Gen. Jadwin and Gen. Jackson, both since dead) as made in official statements; answers by the "private" (Mr. Berthe); and by "old man river," or experience during the 1937 flood. Answers are well documented.

Among the points of general interest are the value of "N" in Kutter's formula to be used in computing flow in the floodway. According to Mr. Berthe, the actual value computed for the 1937 flood was 0.08+, as compared to 0.070 used in the 1929-30 hydraulic studies. Values as low as 0.045 were suggested. The reduction in the Cairo gauge, with the floodway operating was between 2.38 and 3.38 feet, as compared to an estimate of about 7 feet.

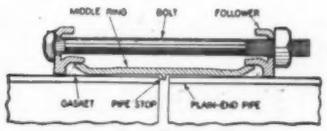
Some good pictures of flood scenes at Cairo are presented; also of scenes of damage in the floodway. Good maps add to the interest of this book.

The appendix of this interesting publication contains data on the 1937 flood and information on other points. For instance, 1937 daily flood stages; data on crevasses in the fuse-plug levee; estimated flow into floodway; freeboards on levees; daily discharges through the floodway; comparative flood discharges, 1913-1937 Ohio and Mississippi rivers.

As previously stated, this is a controversial subject, in which the editors of this magazine, though generally familiar with the problem of flood control along the Mississippi, are not qualified to speak. Mr. Berthe has presented many facts in a clear and interesting manner. Copies can be obtained by addressing "Old Man River Speaks," Charleston, Mo.

"TRUE EVERY TIME! ALL YOU NEED WITH DRESSER JOINTS IS UNSKILLED LABOR!"

A big advantage in laying a line with Dresser Couplings is the absence of skilled labor. Reason: almost anyone can quickly assemble the few, simple, fool-proof parts of the Dresser "factory-made" joint. Only tool required is a wrench to tighten the bolts. No need to bring in skilled labor from distant points. Ordinary labor —inexpensive and easy to get —does the trick.



Cross section, Dresser Steel Coupling, Style 38, showing how it joins *plain-end* pipe in a *flexible*, yet permanently tight connection. Sizes available: ¾" I. D. to largest pipe made.

DRESSER
PIPE COUPLINGS

S. R. DRESSER MANUFACTURING CO.
BRADFORD, PA.
230 Park Avenue, New York, N. Y.
Peoples Gas Building, Chicago, Ill.
Shell Building, Houston, Texas
In Canada: Dresser Mfg. Co., Limited, 60 Front Street, West, Toronto, Ontario

KEEPING UP WITH THE NEWS

American Water Works Association

The 58th annual convention of the AWWA will be held in New Orleans, La., April 24 to 28. This ought to be well attended. Not only is it mighty nice, as a rule, in New Orleans in April, but there is more to the situation than just that.

An unusual flock of special trains will bear water works men toward the south. All of these will meet at Birmingham, Ala., which, without doubt, is one of the finest cities in the country. Down there, where cast iron pipe factories grow in profusion, all of the folks will be out to welcome the delegates. Saturday is usually a non-operating day at the cast iron pipe factories, but in honor of the visitors, most of the plants will be in operation. So, mark off the 23rd for a big day in Birmingham.

But cast iron pipe factories aren't the only thing of interest in Jefferson County, so arrangements have also been made to go over the industrial water supply in the afternoon, and see what a portion of rural Alabama looks like. Probably others will want to look at the steel mills. And there are plenty of golf courses in and around Birmingham. Sorry to say that some of these are laid out on mountain tops, and if you hook or slice, it's just too bad.

The party will leave Birmingham Saturday evening. In New Orleans, too, there is plenty of opportunity for entertainment. Clint Inglee is in charge of one event that we look forward to—that annual water works entertainment.

We haven't had a look yet at the technical program, so there is full excuse for leaving any mention of it till the last. More about this later.

New England Water Works Association

The 57th annual convention of the New England Water Works Association will be held at the Hotel Statler, Boston, Mass., September 13 to 16. Miss Marcella Sachs, assistant secretary, 613 Statler Bldg., Boston, Mass., will furnish further details.

Kentucky-Tennessee Section, AWWA

The Kentucky-Tennessee Section of the AWWA will meet at the Brown Hotel, Louisville, Ky., March 21 to 23. Howard D. Schmidt, 420 Sixth Ave., North, Nashville, Tenn., is secretary.

Texas Water Works School

The twentieth annual session of the Texas Water Works School was held at Texas A & M College, College Station, Tex., on February 14 to 18, under the auspices of the Texas Division, Southwest Section, AWWA, the Texas State Board of Health and the Texas A & M College. The program presented was an excellent and complete one. It is regretted that the space does not permit giving it in full. Those who wish to have a copy of the program may possibly obtain it from V. M. Ehlers, State Sanitary Engineer, Austin, Tex. We believe that the papers will be published later, also.

Personal Notes and News:

H. H. Hendon has been appointed chief engineer of tthe Engineering Department of Jefferson County, Alabama. There are three divisions — Sanitary, Highway and Convict. D. A. Helmich is Highway Engineer, M. E. Boriss is Sanitary Engineer and E. H. Gilmore superintendent of Road Maintenance.

Henry E. Beyster has been appointed Commissoner of Public Works of Detroit, Mich., succeeding L. G. Lenhardt who, in turn, succeeds George H. Fenkel as general manager of the Water Department.

Frank Bachman, in charge of Dorr sanitary engineering activities, is now returning from survey of sanitary projects in India. Dr. Anthony Fischer is now in England in connection with sanitary engineering work.

W. C. Caldwell has resigned from the J. G. White Engrg. Corp. to become Vice-President and General Manager of the building construction firm of Iglehart, Caldwell & Scott, Inc., New York.

The headquarters office of the American Water Works Assn., has been moved to 22 East 40th St., New York City.

Koehring Kolored Katalog:

Another of those most attractively colored booklets put out by Koehring Co., Milwaukee, Wisc. This is a 20-page publication illustrating new excavators. Copy on request.

Blade Graders:

Mechanical features of Caterpillar blade graders are enumerated and discussed in a 2-color booklet, with many action pictures. 32 pp. Ask for Form 4254, Caterpillar Tractor Co., Peoria, Ill.

Sewage Pumps:

Bulletin 964-C, 28 pages on raw sewage pumps that do not clog. Sent on request to Buffalo Pump, Inc., Buffalo, N. Y.

"99" Grader:

Full information on the new Austin-Western "99" grader which drives and steers on all four wheels. Beautifully illustrated; 24 pp. Sent on request. Austin-Western Road Machinery Co., Aurora, Ill.

Air Filters:

Northern Blower Co., Cleveland, O., has issued a 4-page bulletin, No. 500-2, describing their round type air filters.

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These booklets are FREE to readers of PUBLIC WORKS.

Air for Agitation

382. Roots-Connersville positive displacement blowers for moving air under moderate pressure or vacuum in volumes up to 700 cu. ft. per minute are described in Bulletin 21-B 17 recently issued by the Roots-Connersville Blower Corp., Connersville, Indiana. Blowers for larger volumes and higher pressures are covered under other bulletins which are available.

Cast Iron Sewers

384. Cast Iron Pipe for Sewers. For wet grounds, under highways and railways and other severe duty. Details and specifications. U. S. Pipe & Foundry Co., Burlington, N. J.

385. For use in wet ground to prevent infiltration, for crossing under railways and heavy duty highways, and for all other sewer construction where replacement, repairs or reconstruction would be costly, cast iron pipe is most economical. For details, specifications, etc., write Thomas F. Wolfe, Cast Iron Pipe Research Ass'n, 1013 Peoples Gas Bldg., Chicago, Ill.

Couplings for Pipe

386. This sixteen-page booklet is a reprint of a magazine article by a consulting engineer. It describes in detail the installation of a 42" water line; contains specific information regarding pipe joints, field organization, laying pipe, tests, back-filling, etc. Sent free by S. R. Dresser Manufacturing Company, Bradford, Pa.

Feeders, Chlorine and Chemical

387. For chlorinating small water supplies, swimming pools and other installations. Flow of water controls dosage of chlorine (or other chemicals) providing required dosages, which are immediately adjustable. Driving is started and stopped automatically. Send for newest literature. %Proportioneers%, 9 Codding St., Providence, R. I.

Filter Plant Controllers

388. "The Modern Filter Plant" and the uses of Simplex Controllers for operation are described in a handy, 16-page booklet. Charts, data, curves and tables. Simplex Valve and Meter Co., 68th and Upland Sts., Philadelphia, Pa.

Flow Meters

389. The primary devices for flow measurement—the orifice, the pilot tube, the venturi meter and others—and the application to them of the Simplex meter are described in a useful 24-page booklet (42A). Simplex Valve and Meter Co., 68th and Upland Sts., Philadelphia, Pa.

Gate Valves and Hydrants

390. An 84-page catalog gives full design data, information about and illustrations of the complete line of Darling Gate Valves and Hydrants. Write for one to Darling Valve and Mfg. Co., Williamsport, Pa.

Manhole Covers and Inlets

403. Nuisance from loose, noisy manhole covers is eliminated by the use of Westeel rubber cushioned manhole covers and gratings. Six special advantages are explained in a new illustrated bulletin just issued by the West Steel Casting Co., 805 East 70th St., Cleveland, Ohio.

404. Street, sewer and water castings made of wear-resisting chilled iron in various styles, sizes and weights. Manhole covers, water meter covers, adjustable curb inlets, gutter, crossing plates, valve and lamphole covers, ventilators, etc. Described in catalog issued by South Bend Foundry Co., South Bend, Ind.

Pipe, Cast Iron

406. Data on cast iron pipe for water works systems, in sizes from 1¼ to 84 inches, including information on useful life, flow data, dimensions, etc., Thos. F. Wolfe, Cast Iron Pipe Research Ass'n, 1013 Peoples Gas Bldg., Chicago, Ill.

Pipe, 2-inch Cast Iron

407. The new McWane 2" cast iron pipe in 18-foot lengths has innumerable uses in water and sewage work. Send for the new McWane bulletin describing this pipe, the various joints used, and other details about it. McWane Cast Iron Pipe Co., Birmingham, Ala.

Pipe, Large Cast Iron

408. Handy cast iron pipe and fittings catalog contains A.W.W.A. and A.G.I. standard specifications for a wide variety of cast iron pipe specialties, both bell and spigot and flanged; also dimensions Lynchburg Foundry Co., Lynchburg, Va.

Pipe Forms

411. Making concrete pipe on the job to give employment at home is the subject of a new booklet just issued by Quinn Wire and Iron Works, 1621 Twelfth St., Boone, Ia., manufacturers of "Heavy Duty" Pipe Forms. Sent promptly on request.

Pipe Joints

412. New folder describes in detail a new type of pipe joint—the Dresser Compression Coupling Style 65, which is compact and self contained, makes a permanently tight joint under all conditions and is installed on plain end pipe in a few seconds with only one tool, a wrench. Get your copy today. S. R. Dresser Mfg. Co., Bradford, Pa.

Pipe Joint Compound

414. A new bulletin has recently been issued giving full details concerning Tegul Mineralead, a quick-sealing, trouble-free compound for bell and spigot joints which permits immediate closing of the trenches. Write The Atlas Mineral Products Co. of Pa., Mertztown, Pa.

Taste and Odor Control

417. How, when, and where activated carbon can and should be used to remove all kinds of tastes and odors from water supplies is told in a new booklet just issued by Industrial Chemical Sales Div., 230 Park Ave., New York, N. Y. 32 pages, table, illustrations and usable data.

Pumps and Well Water Systems

420. Installation views and sectional scenes on Layne Vertical Centrifugal and Vertical Turbine Pumps, fully illustrated and including useful engineering data section. Layne Shutter Screens for Gravel Wall Wells. Write for these three descriptive booklets. Layne & Bowler, Inc., Dept. W, General Office Memphis, Tenn.

Pumping Engines

424. "When Power Is Down," gives recommendations of models for standby services for all power requirements. Sterling Engine Company, Buffalo, N. Y.

Run-off and Stream-Flow

425. Excellent booklet describes and illustrates the latest types of instruments for measuring run-off, both from small areas for storm sewer design, and from large areas for determining water shed yield. Sent promptly by Julien P. Friez & Sons, Baltimore, Md.

Screens, Sewage

428. Be assured of uninterrupted, constant automatic removal of screenings. Folder 1587 tells how. Gives some of the outstanding advantages of "Straight-line Bar Screens" (Vertical and Inclined types). Link-Belt Co., 307 N. Michigan Avenue, Chicago, Ill.

Setting and Testing Equipment for Water Meters

430. All about setting and testing equipment for Water Meters—a beautifully printed and illustrated 40 page booklet giving full details concerning Ford setting and testing apparatus for all climates. Ford Meter Box Co., Wabash, Ind.

Rainfall Measurement

432. The measurement of precipitation, exposure of gauges, description of apparatus for measuring rainfall, both rates and amounts. Bulletin RG and Instruction Booklet. Julien P. Friez & Sons, Baltimore, Md.

Screens

435. Water Screen Book No. 1252, describes traveling water intake screens and gives complete technical information about them. Link-Belt Co., 307 No. Michigan Ave., Chicago, Ill.

Sewage Filters, Magnetite

436. Well illustrated booklet describes the magnetite filter, and tells how it is used in the treatment of Sewage. Copy on request from Filtration Equipment Corp., 10 East 40th St., New York, N. Y.

Small Septic Tanks

438. Septic Disposal Systems, Waterless Toilets, Multiple Toilets for Camps and Resorts, and other products for providing safer sewage disposal for unsewered areas are described and illustrated in data sheets issued by San-Equip, Inc., 700 Brighton Ave., Syracuse, N. Y.

Sludge Incineration

440. Disposal of Municipal Refuse: Planning a disposal system; specifications. The production of refuse, weights, volume, characteristics. Fuel requirements for incineration. Suggestions for plant inspection, 45 pp., ill. Also detailed outline of factors involved in preparation of plans and specifications. Morse-Boulger Destructor Co., 202P East 44th St., N. Y.

Swimming Pool Equipment

444. A new booklet "Essential Factors in the Design and Layout of Swimming Pool Systems," with data on filtration equipment, fittings, solution feeders, accessories, etc., is available from Everson Manufacturing Co., 213 West Huron St., Chicago, Ill.

445. Data and complete information on swimming pool filters and recirculation plants; also on water filters and filtration equipment. For data, prices, plans, etc., write Roberts Filter Mfg. Co., 640 Columbia Ave., Darby, Pa.

Treatment

448. New 31-page catalog covers complete conveying, screening and reduction machinery for water purification and sewage treatment; describes and illustrates the design features of Jeffrey self-cleaning bar screen, combined screen and grinder, sewage screenings grinder, grit washer, conveyor type and positive discharge sludge collectors and green garbage grinder—includes installation views. Catalog 615, Jeffrey Manufacturing Co., Columbus, Ohio.

450. Standard Sewage Siphons for small disposal plants and PFT Rotary Distributors are new catalogs recently issued by Pacific Flush Tank Co., 4241 Ravenswood Ave., Chicago, Ill. The latter catalog contains typical plans and many illustrations of actual installations.

453. How to avoid sludge and scum troubles in settling tanks explained in detail in Book No. 1542—has excellent drawings and photographs, also specifications. Most important are the carefully prepared capacity tables. Link-Belt Co., 307 N. Michigan Ave., Chicago, Illinois.

454. Full information regarding their newest equipment for sewage treatment and water purification will be sent on request by The Dorr Co., 570 Lexington Ave., New York, N. Y.

Valve Box Tops

475. "Cut the Cost, but Not the Pavement," is the theme of a new bulletin on Rite-Hite Valve Box Tops. Gives directions for forming new tops on valve boxes, quickly and inexpensively without digging up the old box. Just issued by Trohn's Supplies, Inc., 205 Hoyt Ave., Mamaroneck, N. Y.

Water Works Operating Practices

490. "What Is New In Coagulation" is an excellent, new review with bibliography and outlines of latest work done in the field. Written by Burton W. Graham and sent free on request to Activated Alum Corp., Curtis Bay, Baltimore, Md.

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Brief reviews of the latest books, booklets and catalogs for the public works engineer.

Coagulation:

This 16-page text covers the fundamentals of coagulation, the theory of coagulating action, practical applications, and necessary steps in getting good results. It also covers the use of slicates, bentonite and other adsorptive clays, titanium salts and activated carbon and their uses with aluminum sulphate and iron. Also includes a review of literature and a biography. Written by Burton W. Graham. Sent on request to the Editor of Public Works.

ASTM Standards Index:

Gives information on all the 832 standards of the ASTM. All of these are listed according to subject. For instance, asphalt emulsified, surface treatment, (D401-36T), Proc. Vol. 36, 1, 866; also 1937 T. S., 821; or cast iron pipe (A44-O4). B. S., I. 477; or hydrated lime for water treatment (C54-27). B. S., II. 40. 106 pp. Sent on written request, no charge, ASTM, 260 So. Broad St., Philadephia, Pa.

Waterproofing Data:

This is a new edition of the Koppers roofing specification book, but a large portion of it is devoted to descriptions and illustrations showing just how to waterproof and dampproof swimming pools, tunnels, highways, sidewalk vaults, deep foundations and buildings. Roofing specifications are written in blank and ready for inclusion in your specifications. There are also data on spray pond roofs which permit the reuse of water in air-conditioning systems, and water cooled roofs. Insulation, flashing details and metal finishing strip details are covered. Sent on request to R. H. McClintic, Koppers Co., Koppers Bldg., Pittsburgh, Pa.

Makeshift Homes:

This is a preliminary study of the Wisconsin situation from the Municipal viewpoint. It is prepared by Arthur Rabuck and is issued by the League of Wisconsin Municipalities, Madison, at 50 cents. There are 27 pages of closely typed mimeographed material. Order direct from the League.

Zoning Notes:

Mimeographed statement of the session at Chicago. Covers rural zoning, flood plains, blighted areas, roadsides and counties, a summary of contents, etc. National Resources Committee, North Interior Bldg., Washington, D. C.

Pressure Treated Timber:

After describing tthe necessity for treating timber, and the kinds of preservatives employed, this booklet discusses and describe pressure processes, preparation, economy of treated timber and its uses for bridges and many other uses. Many excellent photographs. Koppers Co., Pittsburgh, Pa.

Municipal Snow Removal:

This is a study and report on the practices in 78 cities in the snow belt in municipal snow removal. Covers necessity for careful preliminary planning for snow fighting and the plans, organization, equipment, etc., employed by many of these cities; also equiment used; methods of treating icy streets; snow plowing, removal, etc. At the end are conclusions and valuable suggestions for practice. American Public Works Association, Chicago, Ill. 54 pp.; illus. Price $1.

Sludge Collection:

Link-Belt has issued a booklet on their circular type sludge collection apparatus which includes a number of excellent pictures and drawings of installations, sanitary engineering data and some design details. Ask for Book 1642, M. B. Tark, Link-Belt Co., Philadelphia, Pa.

Hard Facing:

This booklet, the publishers say, describes over 500 money-saving applications of the hard-facing process. There are 104 pages. New sections cover cutting tools and corrosion-resistant alloys. Examples of hard-facing are discussed in detail. Copies on request from Haynes Stellite Co., Kokomo, Ind.

Diesel Performance:

Maximum and rated performance curves of the seven current sizes of Caterpillar diesel engines are included in a well-illustrated, 32 pp. book. Form 4235. Caterpillar Tractor Co., Peoria, Ill.

Road Rollers:

Hercules Co., Marion, O., has issued a new road roller catalog which covers all sizes of their rollers—6, 7, 8, 10 and 12-ton. Sent on request.

Road Machinery:

In this 24-page illustrated catalog is shown the full line of Austin-Western Road Machinery; Motor graders, road graders, hydraulic scrapers, tractor scrapers, rippers, elevating graders, the ½-yd. shovel, rollers, crushing and screening plants, washing plants, sweepers, bituminous distributors, snow plows, fresnos and dump and trail cars. Sent on request. Austin-Western Road Machinery Co., Aurora, Ill.

Street Flushers:

Flushers and sprinklers and a lot of information about clean streets and how to get them. Catalog 304. E. D. Etnyre & Co., Oregon, Ill.